

Final Report

VegNET – NT (NT Farmers)

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VegNET – NT (NT Farmers) VG15044

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Summary

VegNET -NT

VegNET-NT continued to build on industry relationships, developed the previous project, through engagement-focused extension activities with vegetable growers, assisted by stakeholder involvement, to drive the uptake of best practice management in the vegetable industry in the Top End. Most vegetable growers in the NT are from Non-English-Speaking Backgrounds (NESB), predominantly Vietnamese and Cambodian. Earlier vegetable project contributions were essential in achieving best management practices for On-farm Biosecurity in the Northern Territory vegetable industry. The aim of this project was to strengthen growers' business and agronomic models through addressing best-practice gaps and capacity requirements identified through grower feedback and achieved by implementation of existing and current research. Vegetable growers were surveyed annually to verify the extent of the industry, to identify key issues in their farm management and businesses and to gauge the increases in knowledge and skills and any uptake of best practice behaviors.

VegNET -NT used a variety of extension tools and strategies to assist vegetable growers in the NT to learn and adopt best practice farm and business management behaviors to enhance their productivity, sustainability and profitability of their business. VegNet- NT conducted workshops, training, demonstration trials and field events for IPM and green manure cropping. These activities were often in conjunction with complimentary projects such as VegPro, Soil Wealth and Integrated Crop Protection and CGMMV Research. The project worked with cooperating agencies like the NT Dept of Primary Industry and Resources (NTDPIR) to produce and distribute fact sheets on critical information for ongoing biosecurity issues such as CGMMV and for new knowledge developed through the IPM trials. VegNET-NT used a variety of media to increase grower's awareness of best practice issues and involvement the activities of the project with regular articles in the NT Farmers GrowNT magazine and e-news, specific articles on the results and learnings of each year's demonstration trials.

National media, in Landline and ABC News, as well as the ABC NT Country hour, attended a number of VegNET-NT activities and widened the awareness of sustainable activities to the general public. VegNET -NT was active social media with the VegNET-NT featuring regular posts on the NT Farmers Facebook page and Twitter feed. VegNET- NT played a critical role in forming the conduit between the vegetable growers and the NT Government when sudden changes were made to the water extraction licenses critical for irrigated horticulture in the Greater Darwin Area. VegNET-NT contributed to many more general industry issues associated with Developing the North and Improved Biosecurity outcomes. The project assisted vegetable growers to participate in industry events, such as Hort Connections, and to have their concerns and aspirations heard by policy makers and regulators. Details of all these activities can be found in the OUTPUTS section of this report.

A major industry priority arising from the surveys and the stakeholders was to improve pest and disease management in tropical vegetable crops by encouraging the establishment of IPM practices and strategies to combat resistance in caterpillars and mites which were impacting on profitable production in the NT. This became a key focus for the project and provided a central theme and ongoing meeting place for VegNET -NT activities and was incorporated into as many of the Darwin region activities and events as possible.

A demonstration plot was initiated at the local departmental horticulture research station to demonstrate alternative methods of managing insect pest in a range of commercial Top End vegetable crops. This area also provided the NTDPIR entomologists to complete a comprehensive study into pests and beneficial insects over several seasons. The demonstration plot was strategically situated in an area where other meetings, workshops and field activities could be carried out.

The project achieved a significant increase in knowledge of insects affecting the key vegetable crops in the Top End through the extensive monitoring done by the departmental entomologists and the IPM practices that can be used

to manage them. Other best practice topics that were integrated into the demonstration plots included green manure cropping species demonstrations, modelling best practice on-farm biosecurity and low-tech soil moisture monitoring options for vegetable growers.

These IPM practices were adopted by a key group of industry champions and then more broadly by engaged industry participants. The project continued to support these early adopters with regular visits by both project officers and liaison with departmental entomologists. The success in these management techniques on farm was disseminated through the grower's informal networks as well as at designated field days, informal field walks, workshops and farm visits to support adoption.

Keywords

Grower engagement

Industry Champions

Best practice vegetable production

Capacity building

Integrated Pest Management

Demonstration vegetable plot

Pest and beneficial insect

Insect monitoring calendars

On-farm biosecurity

Introduction

The Northern Territory is one of the younger regions for horticulture and vegetable production in Australia. There is a need in this developing region to engage with the growers, to build relationships for improved best practice. The project officer will cover Darwin and Katherine as the major growing areas of the Northern Territory. Vegetable production has increased significantly in the last 15 years, predominantly due to the Vietnamese and Cambodian growers. The Northern Territory relies on its market window with most vegetable production occurring in the Dry season which is the southern winter period and supplies the Traditional wholesale and Asian markets in Sydney, Melbourne and Adelaide.

There are now about 150 of these vegetable growers in the Darwin area (CGMMV survey 2014) as well as about 10 more traditional pumpkin growers in the Katherine Douglas Daly and Mataranka areas. Key vegetables grown are Asian melons, traditional cucurbits like cucumber, squash, zucchini and pumpkin, snake beans and okra with a smaller amount of Asian greens, capsicums, chilies, eggplant, spring onions, tomatoes and herbs. (VG08040 and VG10117). The industry was estimated to be worth between \$30-40million in 2015 even with the incursion of Cucumber Green Mottle Mosaic virus (CGMMV). A more detailed industry production survey will be completed by NT Farmers in 2019.

The Northern Territory is a developing region for vegetable production in Australia. There is a need to demonstrate to growers, current best practice crop and business management and provide ongoing support in adopting research and development. Growing practices such as spray programs, biosecurity, food safety, pest and disease management and product integrity could have implications for the broader vegetable industry in terms of market access and quality assurance. There is also a move to more intensive production in hydroponics and protected cropping which needs significant support.



Photo 1. Cluster caterpillars still on okra after chemical application

The driver for the focus on Integrated Pest Management (IPM) was the emergence of strong resistance of caterpillars and mites to existing conventional chemical treatments and the escalating requirement to spray with little effect across the whole vegetable production region. Growers were becoming increasingly desperate. Okra was particularly vulnerable as the caterpillars could hide in flowers and were difficult to target with contact sprays. Mite damage on snake beans often reduced the effective harvest period for the crop by as much as 6 weeks production. The spraying regimes were assisting the 2-spotted mites to flush as beneficial insects and predator mites were being removed from the system.

The project's main mission was identified as providing growers with alternative pest management techniques of these two pests. Integrated Pest Management (IPM), which had been shown to work in numerous horticulture situations and rescued growers in similar situations offered the most promise. But growers had been told many times about IPM and there had been very little uptake of the practices. There are extensive resources created for southern growing systems and support industries for providing appropriate advice and beneficial insects. Why weren't these practices being used by NT vegetable growers?

The project identified a number of underlying issues that highlighted the challenges for growers to adopt this

practice change. Growers were getting their advice mainly from 2 sources. Resellers sold chemical that were registered on these pests and the growers purchased the cheapest products available. Even when resellers advised the use of new generation softer IPM compatible products they were more expensive and didn't work well as they needed the other parts of an IPM system to work effectively. Those that did, were overused and quickly induced resistant populations. Other growers would tell them what they used on their farms that had worked, which also led to an escalating chemical warfare but often with rotations that involved the same mode of action and again resistance was the end result. Growers became very scared of change as their livelihood depended on constant cash flow from their vegetable crops and they could not see a way to change and still provide for their families.

The Department of Primary Industry and Resources (NTDPIR) had reduced capacity to deliver vegetable extension services, with their R&D effort focused on the major NT horticulture crops of mangoes and melons. VegNET -NT initiated a cooperative approach with the Horticulture section of NTDPIR Plant Industries to utilize their existing resources and engage the growers in adopting the results of previous R, D & E efforts in the Top End. The entomology section of the department had produced an excellent field guide to tropical vegetable pests and beneficials through its ACIAR project in Cambodia, that was relevant to the NT growers and needed to be rolled out. Funding was sourced through Territory Natural Resource Management to translate the field guide into Vietnamese to have a language appropriate resource to mirror the English version.

The idea of a demonstration plot on the local research station that could demonstrate the different outcomes from what they were currently doing and IPM strategies was proposed to demonstrate the difference and de-risk the change in practice for the growers. The project team involved the NTDPIR entomology staff as a key technical resource and the research station farm staff to assist with the site and facilities on the research station to act as a central focus for vegetable extension in the Greater Darwin area. This design extension model as described by J. Coutts 2019 allowed the combined R, D & E resources of the Top End to work as a team and with constant grower engagement to work towards a functional and profitable IPM system for the Top End Vegetable Industry.

Growers could see firsthand the outcomes of the different practices which was backed up with rigorous weekly monitoring data and harvest data to demonstrate the economic advantages of switching to IPM. A number of industry champions took up the practice on their own farms which built on the momentum achieved through the demonstration plot and we started to see significant practice change across the industry. The department re-engaged with the growers at the demonstration plot field events and on-farm and developed a better understanding of the commercial pressures that underpinned vegetable grower's decision-making process and how they may assist them to adopt best practice.

Methodology

Vegetable Grower Engagement

The NT vegetable growers are a very diverse group and include many South East Asian nationalities. In 2013 the Vietnamese growers had just formed an NT Vietnamese Horticulture Association which became the major point of access to these growers. The Cambodian grower community is a smaller tight-knit group centered on their rural temple in Lambells Lagoon. Many of these growers had been engaged in the VG12113 project that identified and engaged growers in developing Best Practice On- Farm biosecurity to maintain their industry through the CGMMV incursion in the NT. Growers outside these groups were approached individually as either members of the NT Farmers Association or as individual growers.

The support industries also provided an excellent avenue to contact growers and assess issues and impacts on the NT vegetable industry. These stakeholders had an economic interest in improving grower profitability and sustainability which translates into best practices and improved communication and logistics for the NT vegetable producers. The project officers have extensive contacts in this area and in the past has partnered with many representatives in these support industries to deliver extension services, conduct demonstrations, on-farm trials and supply chain monitoring and improvement.

A key strategy was to include a number of industry champions on the steering committee for this project. Industry champions are excellent allies in the engagement process. The proposed steering committee includes leading Asian vegetable growers, experienced Territory supply chain operators, Primary Industries staff currently working in the vegetable area and key Association staff. The commitment and energy these stakeholders brought to the project was a major driver in the engagement process. As an ex-extension officer of the NT DPI&F the project manager had on-going high level and operational links with existing research, extension and managerial officers of this department and throughout the Horticulture Industry of the NT. The initial project officer developed links to these major players through the project manager. The subsequent project officer brought a wider set of industry linkages through previous employment with the resellers and irrigation providers.

The initial engagement of the growers was often the key to the ongoing success of this project. The project officer needed to offer something of value, either information or service, during the visits so that there was a development of the perception of benefit to the growers which will lead to good-will and welcome. This banking of social capital is a critical concept in working with Asian growers that have often experienced more withdrawals than deposits from government agencies. As the project developed and best practice issues of pest management, production quality, supply chain and farm business management emerged then the engagement became more individualized, meaningful and mutually beneficial as the project officer responded to the identified needs of the growers.

Growers were encouraged and supported to attend major Industry events such as Hort Connections. VegNET-NT was instrumental in successful in having at least one vegetable grower from the NT to attend each convention in the project period. This was a challenge as the timing of the convention is always at peak production period for the Top End. The growers who attended always recognized the value in the event but struggled with the need to maintain their businesses. These growers were interviewed after the convention and their responses recorded. Appendix 18.

Adopting Best Practice

This project was designed as an engagement and information collection project to build relationships with the vegetable growers of the NT. In assisting the growers towards best practice, it was necessary to survey them for the level of knowledge and skills and their attitudes and aspirations to achieving best practice in their farming and business practices. The surveys and interactions with growers consistently showed a need for targeted extension in the areas of pest and disease management, sustainable soil health, cool chain management, farm labor, supply chain relationships and most critical of all was farm biosecurity and interstate market access issues.

These issues were addressed, in conjunction with the major focus on IPM, using the demonstration area to introduce these practices and reinforce their importance to sustainable production. For example, on-farm biosecurity was modelled at every field event with appropriate practices such as visitor records, footbaths, wash down bays and adherence to the farm biosecurity plan for that site. Sustainable soil health activities were combined with the IPM trial by demonstrating different green manure species options that were incorporated before planting the IPM trial

crops and by observing differences in productivity through soil health outcomes.

The development of industry champions within the grower groups and 3 major locations of Marrakai, Lambells Lagoon and Berry Springs have been very successful with meetings, workshops and field activities being based around engaging these key industry players to encourage participation by growers in their area and will continue to be an integral part of the extension effort into the NT vegetable growing community. The relationships built with commercial players in the sector has also led to greater interaction with growers with many of the resellers looking to the current project officer for guidance and support with technical and practice change issues when dealing with their growers. This wider vegetable industry engagement is valuable in detecting other industry issues such as in the supply and input chains and market access and relationships. Having these relationships already developed gave NT Farmers a solid platform to deliver the outcomes of VegNET NT from the very start of the project.

As a capacity building project, this project focused on engaging and servicing vegetable levy payers in the short term, with the long-term goal of widespread adoption of R&D and practice change throughout the vegetable industry. This was monitored and evaluated on a regular basis as the project progresses. The project featured regular grower workshops, seminars or training programs (minimum of four per year – specific to seasonality) covering a range of up-to-date R&D tailored specifically to each growing region. The delivery of these programs also provided an invaluable avenue through which a better understanding of the industry and the individual needs of the growers can be gleaned. Materials produced through the National Vegetable Levy would be promoted through these forums as appropriate.

The project has worked in conjunction with and uses the products from many other levy funded projects including

- VG16086 Area wide management of vegetable diseases: viruses and bacteria
- VG15027 Vegetable Communications
- VG15028 VegPro Vegetable Education and Training Initiative
- VG15013 Improved Management Options for Cucumber Green Mottle Mosaic Virus
- VG13114 NTDPF Vegetable Pest, Disorders and Beneficials Field Guide
- VG14048 Review of current vegetable irrigation technologies
- VG13076 and VG13078 Soil Wealth Project and integrated Crop Protection
- VG15013 Improved Management Options for Cucumber Green Mottle Mosaic Virus
- VG12033 – Vegetables Australia Magazine column contribution
- AOTGR2-0046 Action on the ground (Nitrogen Emission project row crops)
- National Horticulture Convention (Hort Connections) including Innovation and Export workshops.

Vegetable IPM Demonstration plot

The demonstration plot was a key component of assisting vegetable growers in the Top End to adopt improved pest management strategies and to move towards a fully Integrated Pest Management program on their farms. It was designed to show the differences between insect management practices and to capture detailed information on local insect pests and beneficial insects and allow farmers to see these insects and crop outcomes firsthand without them having to take the initial perceived risk of changing practices on their farm.

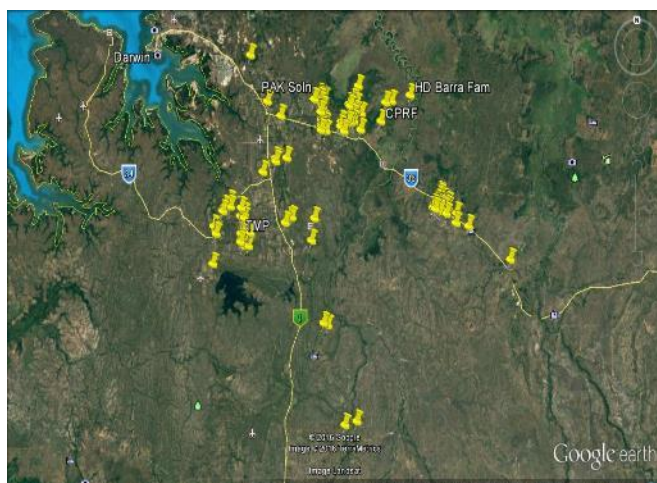


Fig 1. CPRF in relation to Vegetable farms in the Darwin

The site chosen had several critical advantages. The Coastal Plains Research Farm (CPRF) is situated at Middle Point 45km from Darwin and between the major vegetable growing areas of Wanderrie and Marrakai which reduced travel time for growers to attend events. By being in the same general location the suite of pest and beneficial insects would be the same as the farms in the area. The research station had all the equipment and staff to establish and conduct general maintenance of the plot and it had the facilities to conduct meetings in the open air shed. This shed was within 50m of the demonstration plot which enabled easy access to the plot so that field walks could be incorporated into industry meetings and workshops.

Another important consideration was biosecurity. The research station site enabled the project and the departmental staff to maintain strict biosecurity protocols and to reinforce and model these biosecurity best practices at each event. It also removed the risk to farms of disease spread by having the demonstration plot away from their production areas. The site ensured that the demonstration plot would be available for the life of the project and could be varied to emphasize different aspects in each season. The data collected over the three seasons of the project would provide a comprehensive set of data that would account for seasonal variation in insect numbers, timing and behaviors.



Photo 2. Demo plot in the fore ground. Note the extensive Banna grass windbreaks and bio-refuge between the treatments

The demonstration area was designed to specifically compare existing or conventional chemical control methods with a range of IPM practices. The two treatment areas were separated by a double stand of Banna grass which allowed for different control treatments in close proximity but not contaminate each other. The Banna Grass also acts as a bio-refuge for beneficial insects and small animals.

The three-year program was set up as follows.

Year 1: Conventional broad-spectrum chemical spraying program vs a total non-spray treatment. 2 crops

The 2017 planting established the area, with

- windbreaks and bio-refuge of Banna grass defining the treatment area.
- A green manure crop of forage sorghum was planted in January 2017 in both treatment areas and incorporated for a May vegetable planting,
- Plastic mulch was used for all vegetables and trellising was erected for the beans
- 2 rows of Okra and Snake bean were planted in each area. No cucurbits due to the risk of CGMMV.
- The crops were irrigated and fertilized as per common industry practices,
- the monitoring protocols for insect numbers were established by NTDPIR Entomology staff and weekly monitoring was commenced. See Appendix 16 for plot harvest summary data.
- The conventionally treated area was sprayed weekly with a range of common vegetable broad spectrum registered insecticide.
- The crops were harvested regularly, and total harvest yield data collected and analyzed.

- The non-sprayed area outperformed the conventional sprayed area by up 90% increased yield. See IPM articles in Appendix 9 & 10.
- Growers visited the plot on the field day in July 2017 to see the outcomes and data was presented at the TNRM conference in 2017 and at the vegetable preseason meetings in 2018



Photos 3 & 4. Vegetable pre-season meeting and IPM workshop with microscopes at CPRF

Year 2: **Conventional broad-spectrum chemical spraying program vs a total non-spray treatment. 4 crops**

The 2018 planting was in the same area and followed the same pattern

Key Differences

- The treatment areas swapped sides
- 4 different vegetable family crops were planted, okra, snake bean, zucchini and eggplant
- A LandCare Sustainable farming Grant enabled the employment of a casual to collect total and harvestable yield data
- Predator mites were released on the field day
- National media cover through ABC Land Line program
- Informal field walks were used for growers who were reluctant to attend formal field days and workshops due to language difficulties
- Results were analyzed and presented to the growers at the IPM workshops and the 2019 vegetable preseason meeting. See Appendix for insect monitoring and yield data.
- The non-sprayed area outperformed the conventional sprayed area by up 90% increased yield and 60% increase in harvestable yield in some crops. See IPM articles in the Appendices 9 & 10
- A joint VegNet/ NT DPIR poster on the vegetable IPM findings was produced for the TNRM 2018 conference. Appendix 17
- An insect monitoring calendar for the 4 vegetable groups and both management practices was developed. Appendix 1.



Photos. 5 & 6 Vietnamese Vegetable growers inspecting for insects on informal field walk

Year3: **Non-sprayed vs Enhanced IPM**

The 2019 planting again used the same program, weekly insect monitoring, total yield data

Key Differences

- A range of green manure crops were demonstrated
- 4 different vegetable family crops were planted, okra, snake bean, sinquar and chili
- A range of IPM treatments such as soft chemical and beneficial insect release are being used.
- Only total yield data was collected
- Predator mites will be released on the August field day.
- Soil moisture monitoring equipment installed for VegPro Irrigation workshop
- National media cover through ABC Land Line program again is committed for the August field day.
- Informal field walks were again used successfully for growers who were reluctant to attend formal field days and workshops due to language difficulties

Training Activities

Training activities were selected to meet grower demand and where possible to support the IPM pest management theme or to extract the maximum value from the demonstration plot. An example of this was to use G-Dot soil moisture sensors in the demo crops so that the VegPro Irrigation workshop could be held at CPRF and make use of the type of technology that would be appropriate to these vegetable growers.

Other training activities like farm chemical safety courses also included an IPM theme where growers were challenged to think about their chemical use and the efficiency of their programs and application. By constantly reinforcing the theme of improved pest management systems the expectation that the growers would embrace a more sustainable system was built.



Photo 7 G-Dot Soil moisture measurement equipment

Industry Champions and on-farm IPM

There are identified leading growers in the Wanderrrie and Marrakai vegetable growing area identified and engaged through the VG12113 project. One of these farmers was implementing a soft chemical control program and was having reasonable success in the management of caterpillars in his vegetable crops. Initially he struggled to get other farmers in the area to also take up these practices as broad-spectrum insecticides were cheap easy to apply and relatively effective. Over time this changed as a resistant population of spodoptera caterpillars also known as cluster caterpillars were proving a big problem to most growers who were locked in a downward spiral of increasing frequency and rotation of chemicals.

When the other leading grower in the area was also experiencing this, the project with NT DPIR entomologists and cooperating resellers helped the conversion of a small section of his farm to an IPM program. This was very successful and backed up the findings of the demonstration plot at CPRF. These two leading growers then became industry champions for the IPM practices and provide the projects advice to local growers in appropriate language and in the knowledge that the system works as demonstrated by their adoption of these practice changes.

It is common to drop into the sheds of both leading growers about lunch time to see discussions going on with other growers while it is too hot to work outside. We regularly see specimen jars with various insects on the table and the Field Guide produced by VG13114 NT DPIF Vegetable Pest, Disorders and Beneficials Field Guide for Northern Australia being used to identify them. The translation of this Field Guide into Vietnamese funded by LandCare through TNRM has been of great assistance in improving grower's knowledge and their identification and referencing skills.

Outputs

Farm visits and grower face to face contacts

The project officers visited 67 separate vegetable farms in the NT which is 44% of the identified 153 vegetable and mixed farms that have been recorded in the NT Vegetable Growers data base that was also an output of the previous project VG12113. The number of individual farm visits and grower face to face contacts is estimated in the table from the project records but is probably well short of the true total. Some farms, like the project champions, were visited multiple times over the course of the project and often other farmers were there, as these visits were targeted at midday. Growers were finished in the field by this time and were often socializing within their community until work restarted in the cooler afternoons.

Face to face discussions with NT Vegetable growers from project records show that project leader and project officer(s) had 119 visits to vegetable growers in the Darwin Region, 31 visits in Katherine and 21 visits to vegetable farmers in central Australia and Kununurra. This makes a total of 151 farm visits to vegetable growers across the 3 years of the project.

Often these contacts were held off farm as the practicalities of the incursion made it less threatening for the growers. Regular attendance by the project officer at the Rapid Creek, Coolalinga and Palmerston wet markets in the Darwin area made it possible to check in with about fifteen Vietnamese vegetable growers and their families, three Cambodian vegetable market garden families and four growers of Caucasian decent. Many farmers dropped into the NT Farmers office as they were traveling in and out of town or were met in conversation in the many rural supply businesses in the Darwin Rural and Katherine area. Another good place for face to face conversations were the departmental field days and local agricultural shows and numbers for these face to face discussions are difficult to estimate.

The numbers given in the table are those of noted visits and individual contacts in the grower contact spreadsheet and the Microsoft Outlook diary maintained by the project officer. These numbers do not record many of the casual contacts resulting from living in the same community as most of the growers and their families. The project leader had previously taught senior Chemistry, Physics and Agriculture at the local high school and knew the children and parents of this community as students. The project officer has had roles as a reseller for agricultural and irrigation products and also has numerous industry contacts in the Top End. This history was instrumental in maintaining close relationships with many of the farming families.

Grower activities

Knowledge transfer and events

A total of 457 growers and industry stakeholders participated in 16 VegNet initiated events, 4 joint workshops with other project providers and 3 VegPRO training workshops over the three-year period from August 2016 to July 2019.

- VegNET-NT Workshops and field events
 - Water Licence Requirements WS Vietnamese Vegetable growers Aug 2016 (45 participants)
 - Water Licence Requirements WS General vegetable and mixed growers Aug 2016 (17 participants)
 - Water Licence Requirements WS Cambodian vegetable growers Sept 2016 (32 participants)
 - Vegetable Strategic Investment Planning Workshop Nov 2016 (21 participants)
 - Vegetable Pre-season workshop Darwin Mar 2017 (52 participants)
 - Vegetable Pre-season workshop Katherine Apr 2017 (14 participants)
 - Vegetable IPM Workshop Coolalinga June 2017 (17 participants)
 - Vegetable IPM Field Day and WS CPRF June 2017 (33 participants)
 - Vegetable IPM field Walk CPRF July 2017 Vietnamese (6 participants)
 - Vegetable Pre-season workshop Darwin Apr 2018 (20 participants)
 - Vegetable Pre-season workshop Katherine Apr 2018 (17 participants)
 - Vegetable IPM field Walk CPRF June 2018 (8 participants)
 - Vegetable Growers Irrigation WS & IPM Field walk CPRF Sept 2018 (14 participants)
 - Vegetable Pre-season workshop Darwin Mar 2019 (25 participants)

- Vegetable Pre-season workshop Katherine Apr 2019 (15 participants)
 - Vegetable IPM field Walk CPRF June 2019 (11 participants)
- Joint VegNET-NT workshops and field events with other Providers
 - Soil Wealth Field Walk Lambells Lagoon (12 participants) with SWICP project
 - CGMMV Information Workshop Bundaberg Apr 2017 (25 participants) with VegNET- BFVG
 - CGMMV Meeting Katherine Dec (18 participants) VG15013 Improved Management Options for Cucumber Green Mottle Mosaic Virus
 - Irrigation Workshop For irrigation suppliers CPRF Sept 2018 (6 participants) with VG14048 Review of current vegetable irrigation technologies
- Training activities with VegPro
 - Farm Chemical safety Training Vietnamese Growers Sep 2016 (25 participants)
 - FreshCare training Vietnamese July 2017 (10 participants)
 - VegPro Farm Chemical safety Vietnamese and Cambodian Feb 2018 (24 participants)
- Presentations
 - Joint VegNET presentation at National Horticulture Convention May 2017
 - TNRM Sustainable Farming VegNet extension presentation July 2017
 - TNRM Conference Veg IPM presentation Nov 2017
 - TNRM Conference poster 2018 (Appendix 17)
- Grower groups and networking
 - Water Licence Requirements WS Irrigation Suppliers Aug 2016 (18 participants)
 - NTDPIR Coastal Plains Horticulture Field Day Sept 2016 (6 veg grower participants)
 - Vietnamese Horticulture Association Meeting and Xmas Function Nov 2016 (150 participants)
 - Water License Public meeting Humpty Doo Green (120 concerned local citizens and local members)
 - NTDPIR Katherine Research Station Field walk Apr 2017 (4 veg grower participants)
 - Innovations Workshop & National Hort Convention May 2017
 - Vegetable Export Workshop National Hort Convention 2017
 - Centralian Growers Group Meeting July 2017 (3 veg grower participants)
 - Marrakai Progress Association April 2018 (8 veg grower participants)
 - Innovation and Export Hort Connections June 2018 (2 veg grower participants)
 - NACRA Field walk Kununurra WA July 2018
 - NLC/CLC Aboriginal Land and Sea Development Alliance WS Aug 2018
 - Hort Innovation Vegetable Program Approach Meeting Nov 2018
 - Vietnamese Horticulture Association Meeting and Xmas Function Dec 2018 (135 participants)
 - NTDPIR Katherine Research Station Field Day Apr 2019 (250 participants)
 - NTDPIR Douglas Daly Research Farm Field Day Apr 2019 (130 participants)
 - Innovation and Export WS Hort Connections June 2019 (2 veg grower participants)
 - NACRA Field walk Kununurra WA July 2019
- Participation in allied industry events and programs
 - Veg Notes Review Oct 2016
 - Vegetable Weeds Survey June 2017 (3 veg farms)
 - Vegetable judging Royal Darwin Show July 2017- 2019
 - AUSVEG Biosecurity Project NT farm visits Aug 2017
 - Citrus Canker Meetings for Vietnamese and Cambodian Veg and Herb Growers Oct 2018 (15 veg grower participants)
 - AUSVEG Agri-chem & Biosecurity Farm Visits Mar 2019 (6 farms)
- Extension Materials
 - Fact sheets
 - Vegetable Insect Calendars for the Top End (Appendix 1)
 - Aphids IPM control vs broad spectrum sprays (Appendix 2)
 - Brown bean bug (*Riptortus serripes*) (Appendix 3)
 - Two-spotted mite (*Tetranychus urticae*) (Appendix 4)
 - CGMMV factsheets compilation from VG15013 (Appendix 5)
 - Narratives (Appendix 6)
 - Quarantine survey, Informal Field Walks, Biosecurity on-farm, IPM adoption
 - Case studies
 - Soil Wealth NT (Appendix 7)

- IPM Adoption (Appendix 8)
- Communication Materials. NT Farmers contact list includes growers and industry stakeholders
 - Articles
 - Production Article IPM Block 2017 GrowNT (Appendix 9)
 - Production Article IPM Block 2018 GrowNT (Appendix 10)
 - Using G-dots to check on soil moisture May 2019 GrowNT (Appendix 11)
 - Importance of Bio Refuges June 2019 (Appendix 12)
 - Bimonthly GrowNT newsletter
 - 2016**
 - July-August - Coastal Plains Field Day. A mention of Biosecurity page 14
 - September-October – National Vegetable Extension Network – NT page 16
 - November-December – VegeNotes 57 – Enhancing best practice in veg production and business management in NT – page 13-14
 - 2017**
 - January-February – Integrated Pest Management in NT Veg Crops – page 3
 - January – February – Veg and Melon pre-season meeting – page 7
 - March-April – NT Vegetable Growers get set for the 2017 Dry Season – page 8-9
 - May-June – Top End Growers using Native Predators to Eat Bugs Causing Havoc on their Crops – ABC News article – page 10
 - May -June – National VegNET Horticulture Code of Conduct update – page 14
 - July-August – VG15044 – Building Capacity in vegetable businesses in NT. IPM Demo Site project update page 12 – 13
 - September-October – The Front line - Vegetable Leafminer – PHA, HIA & AUSVEG article – page 6-7
 - September-October – Coastal plains VegNet IPM Demo block 2017 – page 8-9
 - November – December – VegNet Project VG15044 – page 4
 - 2018**
 - May-June – Coastal Plains IPM Demo Block – page 16-17
 - July-August – Coastal Plains IPM Demo Block – page 16 and page 17 for water licensing
 - No edition October-November as Annual report – VG15044 VegNet IPM Demo Block Annual Report page 18-19
 - 2019**
 - January-February - New IPM Cover Crop Trials page 6
 - January-February – The vegetable R&D Levy at work Hort Innovation article page 7
 - January-February – preseason veggie and melon meeting page 8
 - March-April – VegNet Project 10544 – page 6-7
 - May-June - The G-Dot system page 6-7
 - NT Farmers weekly enews – distribution list of 350 includes members, allied associations and Gov and industry and stakeholders
 - Vegetables Australia Magazine
 - Around the States column
 - Northern Territory Around the States Aug 2016
 - Northern Territory Around the States Oct 2016
 - Northern Territory Around the States Feb 2017
 - Northern Territory Around the States April 2017
 - Northern Territory Around the States Jun 2017
 - Northern Territory Around the States Aug 2017
 - Northern Territory Around the States Oct 2017
 - Northern Territory Around the States Dec 2017
 - Northern Territory Around the States Feb 2018

- Northern Territory Around the States Apr 2018
- Northern Territory Around the States Jun 2018
- Northern Territory Around the States Aug 2018
- Northern Territory Around the States Oct 2018
- Northern Territory Around the States Feb 2019
- Northern Territory Around the States Apr 2019
- Northern Territory Around the States Jun 2019
- Northern Territory Around the States Aug 2019

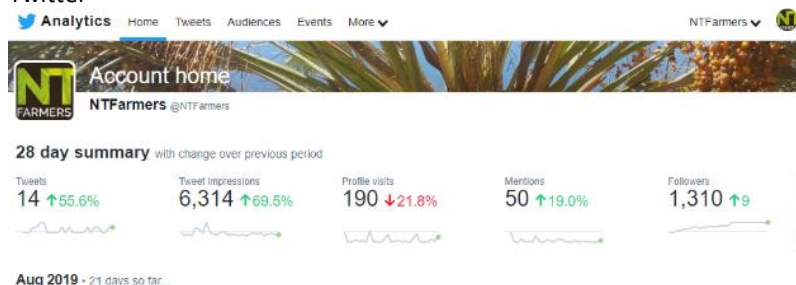
NT Farmers has a very active social media presence

○ FaceBook

Total Page Likes as of Today: 1,232 and 1,236 Followers



○ Twitter



○ SMS messaging

- Growers messaged before workshops and events

• Media

○ ABC Landline

- Landline Story: Vietnamese farmers flourish in the Northern Territory to become Top End's top growers. <https://www.youtube.com/watch?v=Nv7HQLEWwqk>
- Landline Story: IPM in the Top End

You Tube

- VegNet CGMMV posted July 2017 <https://youtu.be/xsuKyYQVRIU>

○ ABC NT Country Hour

- Top End growers using native predators to eat bugs causing havoc on their crops.

By Mitchell Abrams Posted 29 Jun 2017, 5:26pm

<https://www.abc.net.au/news/2017-06-29/farmers-using-native-predators-to-eat-bugs-in-nt/8664732>

- NT farmers ferry 10 tonnes of fruit and vegies to market across flooded, croc-infested river

By Matt Braan Posted 7 March 2018 at 5:30 am

<https://www.abc.net.au/news/rural/2018-03-07/nt-farmers-ferry-food-across-flooded-adelaide-river/9518210>

• Industry coordination and engagement

- NT Biosecurity Reference Group 2016-2019
- Australian Classification Land Use Mapping Project (ACLUMP) 2016-2017
- NTFA Northern Australian Food Futures Conference and Roadshow series 2014 – 2019

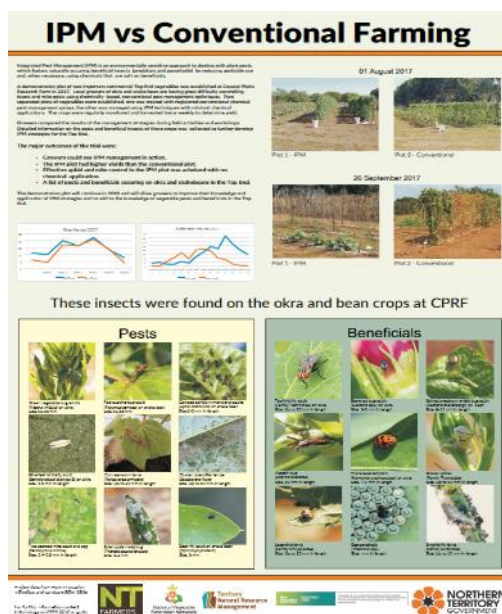
- Northern Australian Quarantine Survey (NAQS) Program 2016-2019
- NT Economic Summit Feb 2017
- CSIRO NAWRA Study 2017-2019
- Austrade Vegetable Exports to Asia Preliminary meeting Oct 2017
- NT On Shore Gas Fracking Inquiry, GESIRA and Community References Group
- NTFA NT Plant Industry Strategic Investment Development Plan 2018 – 2028 May 2018
- NT Farmers Young Farmers Group 2017 - 2019
- Blue Mud Bay Traditional Owners Economic Development Forum Baniyala Jun 2019
- Conference committee APEN 2019 Darwin Conference
- VegNet Meetings (attended in person)
 - Sydney Oct 2016
 - Adelaide May 2017
 - Townsville Sept 2017
 - Brisbane Jun 2018
 - Davenport Sept 2018
 - Melbourne Jun 2019

Data Information materials

- Demonstration plot crop yield and quality data 2017,2018. Available on request
- Demonstration plot Insect monitoring data 2017, 2018, 2019. Available on request

Growers Surveys

- VegNet Post-season survey 2017 Analysis (Appendix 13)
- VegNet Post-season survey 2018 Analysis (Appendix 14)
- Meeting and workshop evaluations at relevant events compiled (Appendix 15)





The Importance of Bio Refuge Barriers for IPM in the Top End

Greg Owens

Why in the NT are we spending so much time on our Banna grass windbreaks and bio-refuges?
Something I ask myself a lot when we're out in the heat of the NT wet season, with the humidity building just before a monsoonal down pour. Establishing the barrier grass is hot and sweaty work in the wet but the perfect weather for bugs to flourish.

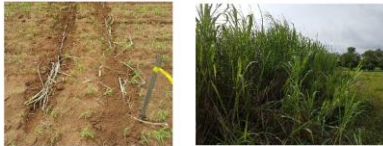


Photo 1. Banna Grass established as cuttings Photo 2 Bana grass forms a dense 3-4m stand

Outcomes

The project **VegNET – NT** responded to key industry issues by facilitating growers to build capacity in on-farm production, regulatory compliance and accessing information and support for practice change, and to move to industry best practice in pest management, on-farm biosecurity and water regulation compliance.

This was done by

- Increasing grower engagement
- Building grower capacity using existing knowledge
- Creating new knowledge
- Increasing adoption of best practice
- Creating a pathway to industry practice change

Increasing grower engagement

The information provided in the Outputs section of this report shows that a total of 457 growers and industry stakeholders participated in 16 VegNet initiated and 4 jointly conducted events and 3 training workshops with VegPro over the three-year period from August 2016 to July 2019. Records show that project leader and project officer(s) had 119 visits to vegetable growers in the Darwin Region, 31 visits in Katherine and 21 visits to vegetable farmers in central Australia and Kununurra. This makes a total of 151 farm visits to vegetable growers across the 3 years of the project, where some grower champions were visited on multiple occasions. The project officers in the process visited 67 separate vegetable farms in the NT which is 44% of the identified 153 vegetable and mixed farms in the Top End. This level of engagement is an increase from the 421 attendances and interactions reported in VG12113. The project can claim at least 67 vegetable businesses but on some occasions these visits would have neighboring farmers also in attendance.



Photo 8 Growers at 2018 preseason workshop

The increased level of engagement is very encouraging as the main driver for the engagement in VG12113 was the mandatory requirement for growers to meet interstate market access conditions for interstate CGMMV. An equivalent driver was the change to the water extraction license regulations in the Greater Darwin Area in 2015. VegNet –NT took a leading role in engaging our Vietnamese and Cambodian vegetable and mixed farm growers, by leveraging on the engagement gains from VG12113 in biosecurity, to ensure that growers obtained the water entitlements they needed for ongoing production. The majority of growers now have been issued appropriate licenses, have installed compliant meters and are providing monitoring data to the Dept of Environment and Natural Resources (NTDENR).



Photo 9 IPM field day 2017 with ABC Landline

Grower engagement in the demonstration plot and on-farm IPM trials was modified after feedback from Vietnamese growers who did not attend the formal pre-season meetings and formal IPM workshops and field days. They commented that they struggled with the language and format and felt they didn't receive much value and their time was better spent on farm than attend these events. A series of informal field walks that gave these growers the opportunity to access the entomologists one on one and tailoring the time to suit their own production schedules, proved successful and were used to enhance the impact of the demonstration plot and the information being generated. Media such as ABC NT Country Hour and Landline broadened that engagement to growers across the NT and Australia.

Building grower capacity using existing knowledge

The VegNet -NT focus throughout the process of obtaining water licenses for the businesses was to build the growers skills for completing the necessary applications and to access the appropriate information to justify their water entitlements. Growers learnt how to access NR Maps, the NT cadastral data base that holds publicly available data on properties and water resources, including bore permits, reports and capacity. Many of the older growers engaged younger family members to assist with the computer skills needed but had the overall understanding of the process to know what information was required and how to put it together in the applications. This improved capacity to take on regulatory tasks is being seen by growers engaging in their own property development applications and applications for land clearing.

The IPM workshops, field days and informal field walks improved the grower's knowledge of pest and beneficials and their skills of identification of these insects (Appendix 15). The demo plot was critical to the growers being able to see the actual organisms as they exist on the main NT vegetable crops. A good example of this was when looking for a Big-eyed bug, a predator of caterpillars in the okra, growers were surprised to see a bug that was only 2mm in length when the field guide photo is huge. The photo had 400x magnification.

This type of interaction improved growers use of the Field Guide, with both English and Vietnamese versions. The larval stage of the 2 main aphid predators, lady birds and hoverflies in Photo 10, look very like caterpillars and before the growers would have killed both with insecticides and actually promoted a huge increase in aphid numbers. This was demonstrated on the conventionally sprayed block Zucchini in 2018. (Fig 2) These 2 predators' larvae completely controlled this aphid out-break on the IPM plot within 3 weeks with the aphids not even spreading to adjoining plants.



Photo 10 Larval stage of predatory ladybird (left) and hoverfly (right) devouring aphids. Identification of these stages is vital to IPM programs.

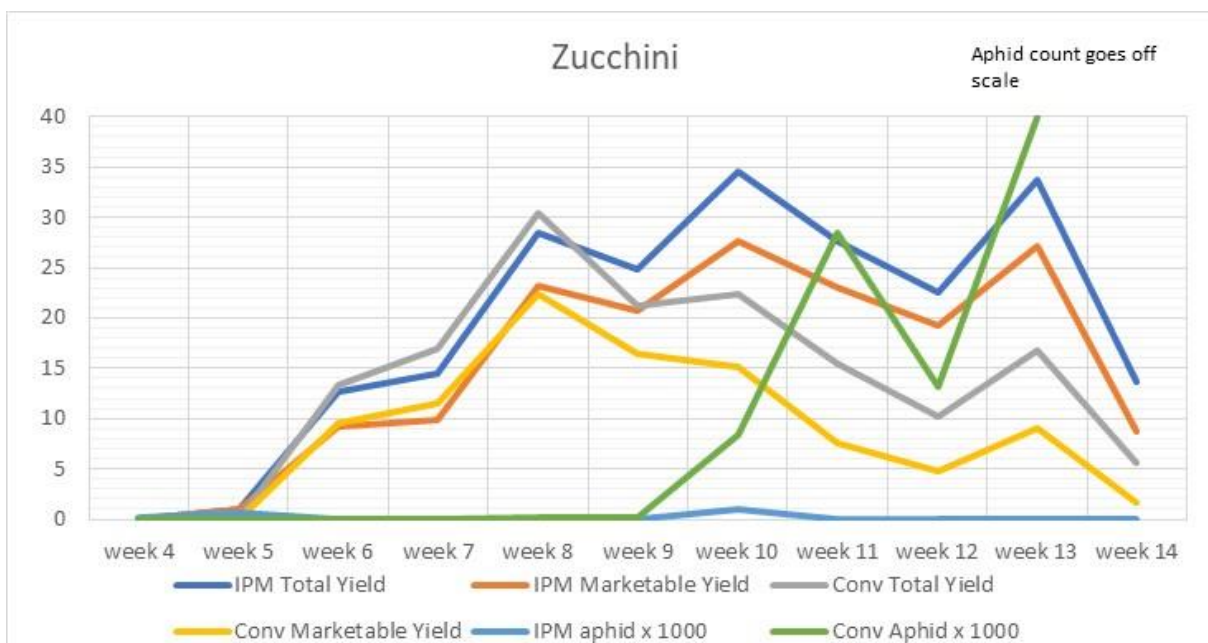


Fig 2 Marketable yield drops on the conventionally sprayed block as predators are killed and aphids increase rapidly. The IPM treatment row of zucchini had 73% more marketable yield.

The individual event and yearly surveys (Appendix 13-15) clearly identified the improvement in grower skills and knowledge of IPM and their aspiration to implement an IPM type program immediately or in the near future. The observations from the researchers identified the increase in ability of the growers to identify what they found in the field and to relate that to the information sources such as the Field Guide.

Creating new knowledge

The demonstration plot created knowledge that was missing for successful implementation of an IPM plan for the vegetables grown in the Darwin area. By doing this in conjunction with grower field activities it became a cooperative research project with growers, researchers and industry development staff working and learning together. Some information already existed. The Field Guide had been published and distributed in English and Vietnamese, there was some information on the effectiveness of predatory mites and the theory of IPM in vegetables was well documented for southern systems.

What was missing was concrete evidence that IPM systems would work in the Top End and what insects and other organisms were involved and how and when they interacted with the crops and each other. The project demonstration plot weekly insect monitoring by NT DPIR Entomology staff generated detailed information of the pests/beneficials timing of arrival, weekly counts (Fig 3) and critical interactions. (Full data available on request to NT Farmers Association) Photos were taken to capture critical information. Regular meetings of the project staff ensured all decisions on insect management practices and outcomes were well discussed and remained within the project objectives even if it meant crop damage.

Weekly Pest and Beneficial Monitoring Sheet - CPHRS																						
Date Sampled: 19 Jun 2018					Name of sampler: Haidee Brown & Michael Neal								Plot: IPM									
Sampling period (time): 10.22 am					Weather: Sunny																	
			PESTS											BENEFICIALS								
Row Number	Sample	Crop	Aphids	Mites	Whiteflies	Caterpillars	Caterpillar eggs	Green Vege Bugs	Other bugs	Pumpkin beetles	28 Spotted ladybird	Other Beetles	Thrips	Ants	Spiders	Predatory beetles	Predatory bugs	Lacewings	Syrphidae	Bees	Wasps	Flies
4	1	Zucchini																				1
	2									1A												1
	3		20+							1A					1							
	4					1EM					1A								40E			
	5					1L																1A
	6					1L											1A		25E			
	7																1A					
	8			100+													1					
	9					3	1L			1A	1A					1						
	10									1A						1			20E			

Notes: 4.2 *Graptostethus* sp.; 4.3 Flatid; 4.4 *S. litura* egg mass; 4.5 *Diaphania indica* larva; 4.6 *D. indica* larva, *H. octomaculata*; 4.7 *H. octomaculata*; 4.8 Preying mantid; 4.9 *D. indica* larva; Flatid; 4.10 Flatid

Fig 3 Weekly Insect Monitoring data sheets

Fig 3 Weekly Insect Monitoring data sheets

This information for the last 2 seasons was synthesized into a pest and beneficials monitoring calendar that can be used for all 4 plant families of crops grown in the Top End. The full calendar was released to growers in the recent Field day at CPRF and is attached. (Appendix 1)

	Field Guide Ref.	Common name	Scientific name	Eggplant IPM											
				Early Growth	Flowering	Fruit									
PESTS	10-31	Native aphid	<i>Aphis asper</i>												
	80-81	Spider mites	<i>Tetranychus</i> sp.												
	88-89	Whitefly	<i>Bemisia</i> sp.												
	16-57	Cluster caterpillar	<i>Spodoptera litura</i>												
	58-59	Corn earworm/ native budworm	<i>Heliothis virescens</i>												
		Cotton hopper	<i>Aphis</i> sp.												
		Leaf roller	<i>Tortricidae</i>												
	44-45	Green vegetable bug	<i>Nezara viridula</i>												
	50-51	Red sucking bug	<i>Pyrausta nigrilinea</i>												
		Redbanded shield bug	<i>Pyrausta nigrilinea</i>												
BENEFICIALS	120-123	Grasshoppers	<i>Grasshoppers</i>												
	88-89	Spider	<i>Spider</i>												
	88-89	Big eye beetle	<i>Meloidae</i>												
	88-89	Spotted ladybird	<i>Harmonia octomaculata</i>												
	88-89	Predatory beetle	<i>Chilocorus</i> sp.												
	88-89	Transverse ladybird	<i>Coccinella transversalis</i>												
	108-109	Spined predatory shield bug	<i>Chalcididae</i>												
	102-103	Assassin bug	<i>Scutiger</i>												
	116-117	Lacewings	<i>Lacewings</i>												
	110-111	Hover fly	<i>Syrphidae</i>												

Fig 4 Eggplant IPM Pest and Beneficials Monitoring Calendar page

This information showed that every type of beneficial the project staff thought we may need to introduce was actually already in the Top End environment and arrived in relation to pest build up and would control most pest problems if not killed. The initial *Spodoptera* caterpillar issue was quickly and effectively controlled by Spiny Shouldered Shield Bug, Bug-Eyed Bug and a host of predatory spiders and small frogs.

This knowledge gave the team confidence that IPM could work on-farm given a change in pest management approach by growers. The data was analyzed and synthesized into a vegetable monitoring calendar that growers can use to plan their monitoring and know what to look for when. It also provides information on the time gaps between increasing numbers of pest insects, the arrival of the beneficial insects and time taken to control the outbreak without broad spectrum chemical use. A vital component of a successful IPM program.

By collecting yield data in 2017, from the 2 different treatments and yield and marketable yield data in 2018 the team was also able to demonstrate a positive economic outcome with higher yields and marketable yields, from the IPM treatments over the conventional sprayed treatments, even before the reduced costs of spraying were included. (Appendix 16) This information was reinforced by the visuals such as the impact of the 2 spotted mites out of control on snake beans with the use of conventional chemicals and totally under control with the release of predator mites and no broad-spectrum chemical applied. The IPM poster presented to the 2017 NT Territory Natural Resource Management conference highlighted this outcome. (Appendix 17)

Increasing adoption of best practice

The case study provided (Appendix 8) of a leading grower implementing IPM on his farm demonstrates the shared learning in this space by the project officers, department entomologists and the farmers. The case study clearly shows that the gaps in knowledge and skills of all the participants were a very real barrier to the uptake of best practice pest management. The plethora of research conducted over the years in other Australian locations pointed strongly to the belief that IPM would work in the Tropics but without the key learnings that come when the process is tried on location first and then on a working farm it was almost impossible for growers to be successful in an IPM program for the Top End.



Photo 12 Champion grower and project leader

The use of industry champions is then the key technique to increase adoption of these practices across a region. The means the champions had to be successful, which in turn requires that the information given to the leading growers has to be specific to their crops, correct, understandable and concise. The grower had confidence that they had access to the project team at all times and could ask questions and receive support as and when it was required.

The IPM workshops and field days became a venue for our leading growers to discuss their journey to IPM and other growers respected the information from their peers and the feedback sheets from those activities clearly demonstrated an aspiration to adopt more sustainable pest management strategies. All these workshops demonstrated best practice on-farm biosecurity practices as the NT transitioned to be clear of banana freckle but started dealing with a citrus canker outbreak. Most of the mixed farmers grow some bananas for the local markets or kaffir lime leaf as a herb for interstate sale.



Photo 11 Trissolcus parasitic wasp found emerging from parasitised Green Vegetable Bug egg raft at CPRF. The dark GVB eggs have all been parasitised.

The demonstration block identified situations where broad-spectrum insecticides were vital in the program such as control of bean fly with dimethoate on plants under 4 weeks after planting, but also showed growers how that still fitted within an IPM strategy if used correctly. This had an unexpected impact on the growers. They knew that it was a necessary part of their snake bean program but were reluctant to discuss it because the impression given by IPM zealots was that all broad-spectrum chemicals were “bad” and felt kind of guilty that they used dimethoate. Discussing the fact that it is absolutely necessary, validated the grower’s knowledge of what was needed on their crops and provided a platform for discussing other chemical use and alternatives. If used as required dimethoate is broken down by the time beneficials are needed in these crops.



Photo 13 Entomologists and reseller

Results of the on-farm IPM trial



Photo 14 heavily infested okra with highly resistant spodoptera caterpillars

4 weeks of no insecticide



Photo 15 Spiny Shouldered Shield Bug devouring caterpillar



Photo 16 Clean okra the proof that beneficials can control the caterpillars.

Establishing the pathway to industry wide practice change

When the leading grower was achieving better pest management and higher yields with less cost, they became champions for the improved practice. As champions and early adopters, they have led the changes in their communities. This has the support of all the local industry stakeholders. The growers also saw the project team working with the local agronomists and resellers to find more sustainable solutions to pest management issues. The degree of uptake of these practices will be evident in the increasing sales of beneficial insects and softer chemical options and the decrease in sales of the bulk of broad-spectrum chemicals.

The pieces are all now in place for industry wide practice change. The knowledge gaps for specific Top End crops, pests and beneficials have been filled. Growers have increased capacity in knowledge and skills to implement IPM and the industry champions have demonstrated and continue to advocate for changes to more sustainable practices. Resellers and industry stakeholders have supported and participated in the learnings from the project and can supply advice and options for growers with confidence. The network is in place to give growers the ongoing support they will require.

Evaluation Level	Project Details	Achievement
	<p>events and main messages being promoted in region.</p> <ul style="list-style-type: none"> 30% of industry are better able to identify issues and opportunities and access information or resources to make appropriate changes. <p>Practice change</p> <ul style="list-style-type: none"> Increased adoption of improved practices and innovation: 40% of growers across all industries adopt one or more of the targeted management improvements/innovations. <p>Indicative Impact</p> <ul style="list-style-type: none"> The 50% of growers who make one or more of the targeted changes will have improved their profitability by a minimum of 5%. 	<p>growers identified in the VG12113 data base and are participants in at least one activity. Engagement with the remainder occurs at industry networking events such as the Viet AGM & Xmas event which regularly has attendance of 150+.</p> <ul style="list-style-type: none"> Feedback from vegetable preseason meetings and field days indicate that growers who attend these meetings are engaged in the learning process and are better able to present their problems and aspirations to project staff and to identify the learning opportunities that best suit them as individuals. At the preseason 2017 event 94% of responders indicated they had a positive experience and 67% would be returning to the next VegNet event. The end of year survey for last season in 2018 showed that 40% of responders had changed their pest and disease practices to an IPM based system with another approx. 40% intending to. In Biosecurity the practice change is 90% with the rest of the responders intending to upgrade their biosecurity practices. The narratives provided demonstrate some of the pathways to these practice changes The case study for IPM adoption (Appendix 8) indicated a change from almost no saleable okra to a clean crop with reduced spray costs and less chemicals. The narrative for 2109 tells of a farmers practice changes that have resulted in a 35% increase in Yield from a 70% drop in spraying and associated reduction in chemicals costs. (Appendix 6)
<p>Influencing Activities [expected to be undertaken during the project]</p> <ul style="list-style-type: none"> Communication activities 	<ul style="list-style-type: none"> Communication Weekly e-News Bulletin Bi-Monthly articles in Newsletter Bi-monthly article in AUSVEG Magazine Facebook page 	<ul style="list-style-type: none"> The Outputs section of the report details the communication items produced through the course of the project. The project also generated significant media with 2 Landline stories and mentions on ABC news and Country hour.

Evaluation Level	Project Details	Achievement
<ul style="list-style-type: none"> Extension Activities – field days, farm walks 	<ul style="list-style-type: none"> Twitter page SMS alerts for issues arising and events Face to face meetings Member briefings Industry engagement 12-monthly update meetings with consultants and service organisation representatives Extension Delivery of 4 Annual Grower Activities a year: including workshops, field days, seminars, farm walks and other capacity building activities, across three main vegetable crops. Assistance and participation in vegetable industry events Attendance to National Horticulture Convention Attendance at Trade Show Hold 1 multi-vegetable field day Targeted one-on-one visits with vegetable producers to assist with R&D take-up 	<ul style="list-style-type: none"> NT Farmers social media profile continues to grow with interactions increasing to Facebook Likes 1,232 and Followers 1,236 and with 1,310 Followers on Twitter. The NTFA young Farmers page is especially active with 443 likes. Regular meetings occurred between NTDPIR extension, research station and entomology staff to discuss the planning and optimal use of the demonstration plot. The industry stakeholders were included in the end of season surveys and indicated they were strongly supportive of activities and could identify improvements in grower knowledge and skills and increasing intention to implement better practices in pest management. A completed list of activities is listed in the Output section of this report and meets these requirements including 20 VegNet formal activities over the life of the project with a total of 457 participants The Demonstration areas were designed using crops from the major vegetable family groups grown in the Top End, cucurbits, beans, Solanaceae, and hibiscus. The timing of Hort Connections continues to be the biggest impediment to NT growers attending the event. This is the common problem highlighted in all 3 evaluation interviews conducted and included in the evaluation material. (Appendix 18) Feedback sheets for the vegetable field days and events show the majority of growers that attend are learning and are either changing their practices or seeking support to do so in the future. The project conducted 119 one to one farm visits and consultations across the three years of the project.

Evaluation Level	Project Details	Achievement
	<ul style="list-style-type: none"> Facilitate a network of leading growers in each sub-region. Develop a flexible program of informal meetings and farm visits. To foster innovation at farm level. Participate in relevant industry and regional networking meetings 	<ul style="list-style-type: none"> An informal network of industry champions now operates at Marrakai and Wanderrie in both the Vietnamese and Cambodian communities. The VegNet project leader and officer attended and participated in a range of allied industry and government events and programs as shown in the Outputs section.
Outputs <ul style="list-style-type: none"> New information products or packages New understanding or knowledge 	Extension materials <ul style="list-style-type: none"> Grower friendly R&D information and project results <ul style="list-style-type: none"> 5 technical notes 3 simplified R&D reports on specific vegetables Strategic Events calendar – in conjunction with other industry providers. Project reports <ul style="list-style-type: none"> Annual Operating Plans MER Plan Updates to Hort Innovation 6 monthly milestone status reports Mid-term project review report <ul style="list-style-type: none"> Final report 	<ul style="list-style-type: none"> The results of the IPM demonstration plot were summarised on a number of fact sheets and articles listed in the Outputs section. The project calendar for growers ended up being only marginally useful as seasonal and personnel factors overran selected dates for local events. The events calendar on the NT Farmer e-news became the best planning tool for growers to see what was coming and where they could engage. Project documents and milestone reports were completed and submitted on time to Hort Innovation as required. (Appendix 20, 21) The midterm report by Coutts JR found “the project was progressing satisfactorily compared to the contract” and “...partnerships with industry leaders/champions to be key in remaining focussed on industry specific and relevant issues.” The final report was submitted with a short delay due to the project leader’s family issues.

Evaluation Level	Project Details	Achievement
<p>Foundational Activities [planned to be used to undertake and advise the project]</p> <ul style="list-style-type: none"> • Advisory Committees • Project team – including producer members • Formation of a Project Reference Group from NT DPIR, TNRM and Local Leading Growers • Funds and in-kind 	<p>Development</p> <ul style="list-style-type: none"> • Provide feedback to Hort Innovation on R&D gaps and needs. • Subcontract the development of grower-friendly materials and reports from R&D outputs. <p>Governance</p> <ul style="list-style-type: none"> • Link with Coordinating project • Staffing: industry Services officer; Extension Officer; industry development officer • Organisation support staff • Informal Advisory Group 	<ul style="list-style-type: none"> • R&D gaps were identified in VG12113 that preceded VG15044 in the NT and had a clear focus on the need for information and adoption of improved pest management strategies. • NTDPIR entomology and communications groups have assisted in the production of materials as their contribution to vegetable extension in the Top End. Territory NRM provided funding a casual officer for detailed data collection for the second year of the demonstration plot. • Project records on finances and staffing were maintained by NT Farmers administration staff. (Appendix 21) • The NT project officer attended all in-person VegNet meetings and planning events and the majority of phone and computer meetings. Interviews with project staff • The project officer maintained constant communication with Hort Innovation staff.

Recommendations

The recommendations below are based on the lessons learnt from the first phase of the VegNet project, feedback from industry and key stakeholders with an understanding of R & D needs of the Northern Territory vegetable industry.

- The continuation of the VegNet project nationally for the benefit of all 11 regionals into the proposed second phase over a 4-year period with the option for a fifth year, is crucial to provide on-going support for industry to adopt best practice management strategies and access up to date industry research.
- Extension modelling and mentoring for VegNet officers through, regular extension method sharing, attending APEN conference yearly for the duration of Phase 2 and utilising APEN mentoring program as a requirement in Phase 2 for up-skilling extension delivery.
- Adopt the recommended outcomes from the VG18003 extension scoping meeting and R & D review of VegNet extension to maintain best practice delivery and industry relevance.
- Focus on supporting adoption with the use of project outputs produced from VG15044 and allied projects such as the Insect Monitoring Calendar, the Pest and Beneficials Field Guide and the insect identification videos currently being produced by VegNet and NTDPIR extension partners.
- Communicating project success and lessons learnt through various industry channels to create awareness and allow the opportunity for knowledge up take via online portals and social media.
- Streamline reporting requirements to allow VegNet staff more hands-on time, on farm and in the field with producers, to present and enable best practice change at the farm level.
- New project suggested focus areas for the NT
 - Protected Cropping for profitability and sustainable farming production
 - Market access options for export potential direct out of Darwin Port
 - Product quality, harvest models for staff training, charts for picking stage and maturity or insect monitoring.

Refereed scientific publications

No refereed scientific articles were produced by this project

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report

Acknowledgements

The project would like to thank the members of the VG15044 reference group for their contribution to the project. The members of the reference group have given their time and energy in making sure the project was what was needed by the growers and was delivered in the best way possible.

The Industry Champions were invaluable to the project. By implementing IPM techniques and allowing other growers access to their farms and learnings, they continued to play a strong role in assisting with the engagement and dissemination of key information and coordination within their communities. A large vote of thanks to these dedicated community members.

The project specifically would like to thank the Entomology staff at NT Department of Primary industry and Resources for the dedication to weekly monitoring and application of pest control measures and the farm staff at Coastal Plains Research farm who assisted in site preparation, irrigation and maintenance. The assistance provided by TNRM through its Sustainable funding grants and staff involvement was much appreciated and allowed high quality data to be collected and used.

The assistance and support of Hort Innovation staff, other VegNet officers across Australia and the VegPro team was most appreciated especially with the change in project officer in the middle of the project. This allowed the project to achieve its outcomes with little interruption.

The project would like to acknowledge the support of the Staff and Board at NT Farmers Association in providing an environment that totally focused on getting the best outcomes possible for the NT vegetable growers and making the meeting room facilities available in such a way that even the most skeptical grower felt that they had a place that they could be comfortable in and the events could help them.

The project would like to acknowledge the other supporting agencies and grower groups who assisted in the development and/or delivery of the project including, AUSVEG, NTDPIR, NTDENR, TNRM, and AMA.

Appendices

- Appendix 1. Vegetable Insect Calendars for IPM and Conventional Insect Management in the Top End
- Appendix 2. Aphids IPM control vs broad spectrum sprays
- Appendix 3. Brown bean Bug fact sheet
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Vegetable Insect Calendars Managing Insects in Vegetable Crops for Top End

To be used in conjunction with the Vegetable Field Guide

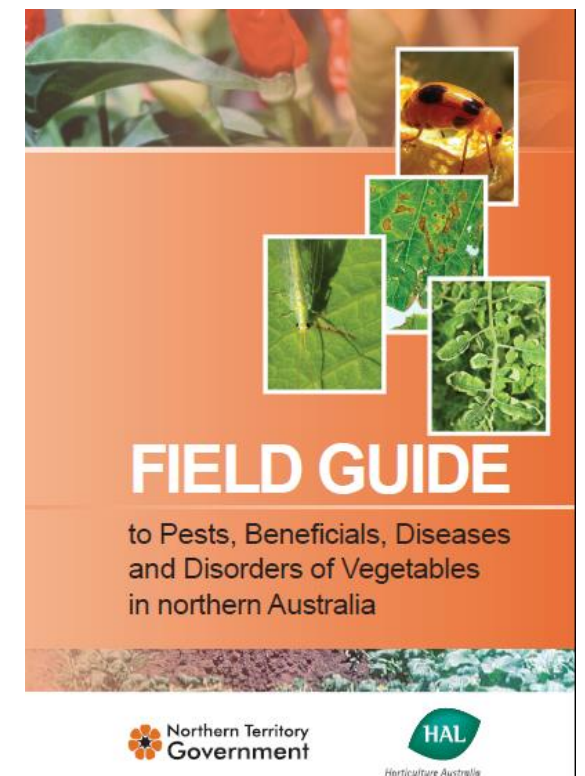


National Vegetable
Extension Network
N O R T H E R N T E R R I T O R Y



IPM
TECHNOLOGIES

BUGS
FOR
BUGS



 **Territory
Natural Resource
Management**



**NORTHERN
TERRITORY**
GOVERNMENT

**Hort
Innovation**
Strategic levy investment

**VEGETABLE
FUND**

This project has been funded by Hort Innovation, using the Vegetable Industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Vegetable Insect Calendar for Top End using Integrated Pest Management Techniques for Insect Management

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Aphids IPM control vs broad spectrum sprays

Description

Aphids are pear-shaped, soft bodied insects that vary in colour from brown, dark green, dull black to yellow depending on species and host source. They have two black tubes (siphunculi) at the rear of the abdomen. There are winged (alates) and wingless forms. Aphids are usually found in large groups on leaves, stems and buds.

Life cycle and biology

Females give birth to live young with or without mating, which allows the population to increase rapidly in a short period of time. Nymphs go through five instars before becoming adults. Some species of aphids produce sexual forms which mate and produce eggs. Most adult aphids are wingless. Winged aphids (alates) are produced when the colony is stressed due to over-crowding or a shortage of food. A generation is completed in 5-7 days in warm weather.

Damage:

Aphids can be found on many different hosts including bitter melon, melons, okra, beans, zucchini and many vegetable and tree crops. They tend to aggregate and may be seen only on a few leaves, they feed on the undersides of leaves by sucking sap from the soft growing tips. Damage is seen as leaf curling, distortion of new shoots and even death of foliage. In heavy infestations the crop may be destroyed. Aphids produce honeydew, which accumulates on the leaves and promotes the growth of sooty mould which hinders photosynthesis. Ants are often seen tending aphids for their honeydew. Aphids are capable of transmitting viruses such as the mosaic viruses of cucurbits.

Control

Integrated Pest Management is the management of pest populations using all available control practices such as biological control, cultural control and chemical control, so that pest populations will be maintained below the economic injury level and any adverse effects to the surrounding environment are minimal. Crops are monitored for insects at regular intervals and sprays are only applied if necessary using soft chemicals where possible.

The trial at CPRS comprises two growing plots, Plot 1 using IPM practices and Plot 2 using conventional (CONV) methods. We planted one row each of snake bean, okra, eggplant and zucchini in each plot. Each plot was monitored on a weekly basis for pests, predators and parasites. The IPM plot was sprayed initially for bean fly

and a couple of times for powdery mildew. The CONV plot was sprayed every week with an insecticide and also for powdery mildew.

The aphids on the okra and zucchini in particular in the CONV crops were badly affected by aphids and resulting honeydew, the population increased to a level that was difficult control with insecticides and the lack of naturally occurring predators made it worse. In contrast the IPM plot had aphids on the crops but these never got out of control. There were healthy populations of predatory beetles present on these crops.

Aphid Nymph's on Beans



Fact Sheet

ENT-12

23 August 2018

Brown bean bug (*Riptortus serripes*)

Haidee Brown, Entomology

Introduction

Brown bean bugs are native to Australia. They can be found in the Northern Territory, Queensland, and New South Wales and in the top of Western Australia. They are pests of snake beans, soybeans, mung beans and pigeon peas. They will also feed on leguminous weeds, grasses and other horticultural crops.

Appearance

Eggs are round with a flattened top and are brown in colour. Size: 1.5 mm across.

Nymphs are 'ant like', elongate and brown in colour and without wings. Size: 2-18 mm in length.

Adults are brown in colour with a yellow stripe running along each side of the body, the stripes are paler in females. They have a spine on each shoulder and the body is narrow in the middle with the abdomen being more rounded in the female. The hind legs are spiny. Size: 16-18 mm in length.



Egg



Nymph



Adult

Life Cycle

Female adult brown bean bugs lay eggs singly onto leaves. Once hatched they go through five nymphal instars before their final moult to become an adult. Adults are fast flyers.

Symptoms and Damage

These bugs feed on the pods within the outer casing of the bean by stinging the pods and sucking out the juices. Damage to young pods causes them to become deformed and dried out. It also reduces the quality of the seed and affects yield. Pods can turn brown and become shrivelled.



External damage to
snake bean pod



Shrivelled snake bean
seed



Shrivelled snake bean
seeds

Monitoring

Crops should be monitored from early to mid-morning. Adults are agile and will fly readily when disturbed, nymphs are found hiding amongst the leaves.

Pest Management

Brown bean bug eggs are parasitised by *Trissolcus* sp. (Scelionidae) wasps. Tachinid flies and assassin bugs may attack the nymphs.

Chemical control is available for further information contact DPIR entomology on (08) 8999 2258 or email: insectinfo@nt.gov.au.

References

Helen Tsatsia & Grahame Jackson (2017) Pacific Pests and Pathogens - Fact Sheets, Bean pod sucking bug (018). *Pacific Pests and Pathogens*. Available at: http://www.pestnet.org/fact_sheets/bean_pod_sucking_bug_018.pdf

P.T. Baily (Editor) (2007) Pests of Field Crops and Pastures, Identification and Control. CSIRO Publishing.

Fact Sheet

ENT-12

23 August 2018

Two-spotted mite (*Tetranychus urticae*)

Lanni Zhang and Haidee Brown, Entomology

Introduction

Mites are microscopic arthropods that are classified in the order Acarina. They are not insects but are related to ticks and spiders. There are over 40,000 described species of mites in the world. Some of them live freely in soil or water; some are found on plants and some are associated with other animals. Due to their small size most of them are difficult to see with the naked eye.

The two-spotted mite, *Tetranychus urticae*, is one of the most economically important species. In the Darwin area it is often a serious pest in the dry season, and has been recorded on vegetables such as snake beans, eggplant, taro and fruit such as watermelon, carambola, pawpaw and ornamentals such as palms, heliconias, gerberas as well as many other native and horticultural plants

Appearance

Eggs are round and translucent white, pale yellow or green in colour with red eye-spots before hatching. Size: About 0.1 mm in diameter.

The immature stages resemble the adults except in size and they have three pairs of legs at larval stage and four pairs of legs at pre-mature and adult stage. They are yellow-green with a dark spots. Size: 0.4 mm in length.

Adults are oval shaped with four pairs of legs. They are usually greenish-yellow with a dark spot on each shoulder, but they may vary in colour depending on what host they are feeding on. In dry cold weather they may be orange-red. Size: Females are 0.4-0.5 mm in length, the males are smaller.



Adult and egg



A watermelon leaf showing feeding damage

Life Cycle

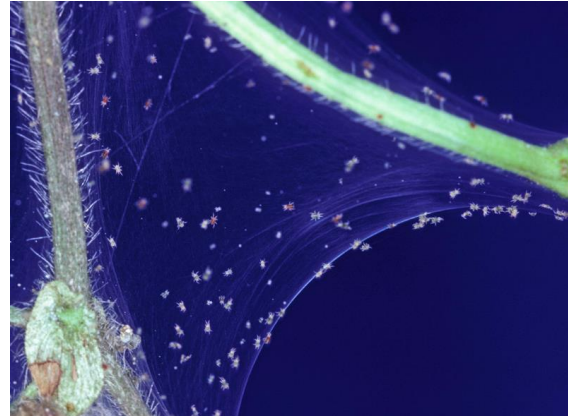
Female mites lay their eggs singly on the underside of the leaves near a vein. Females can lay up to 20 eggs per day and more than 100 eggs in a lifetime. Once hatched the larva goes through two nymphal stages (protonymph and deutonymph) before becoming an adult. Development from egg to adult takes about one week in the tropics, so there may be many overlapping generations in a single season. Their populations can increase rapidly and cause extensive plant damage in a very short time when conditions (temperature, humidity and food) are suitable. Adults can live for up to 30 days.

Symptoms and Damage

Two-spotted mites have needle-like mouthparts and feed by piercing the leaves of host plants and sucking out the fluids from plant cells. Feeding causes yellow spots on the leaves and in heavy infestations, foliage has a yellowing or bronzing appearance and may suffer from premature leaf drop. In situations where there is severe damage this may lead to plant death. Mites prefer the young leaves, however in heavy infestations, the older leaves are also affected and sometimes webbing may be seen all over the plant.



Damage to taro leaf



Two-spotted mites and webbing on bean plant

Monitoring

Monitoring should begin shortly after germination in the early dry season and continue weekly throughout the life of the crop. Inspect the upper and lower leaf surface of new and medium aged leaves for whitish, yellowish or bronzed patches or spots. With a hand lens (with X10 or 20 magnification).

Pest Management

Natural enemies include native phytoseiid mites, six potted thrips (*Scolothrips sexmaculatus*), green lacewing larva (*Mallada signata*), predatory midge (*Feltiella acarivora*) and predatory beetles (*Stethorus* sp. and *Scymnus* sp.).

Biological control of spider mites has been successful in some countries. In Australia, the predatory mites, *Phytoseiulus persimilis* Athias-Henriot and *Typhlodromus occidentalis* Nesbitt are available commercially for control in some crop situations.

Regular use of miticides may kill predatory mites or create problems with pesticide resistance in the plant feeding mites. Soft chemical sprays such as petroleum oil and potassium soap are effective in controlling certain species of mites in crops. When using potassium soap 2ml per L of spray oil is usually added to the spray. Goods spray coverage is essential when applying pesticides. When applying pesticides ensure that you read product labels and only use as directed.

Advice on chemical control is available from DPIR Entomology on (08) 8999 2258 or email: insectinfo@nt.gov.au.

References

Chin, D. et.al. (2014) Field Guide to Pests, Beneficial's, Diseases and Disorders of Vegetables in northern Australia. Pp. 80-81. Department of Primary Industry and Fisheries, Northern Territory Government.

Young, G. and Zhang, L. 1998. The IPM of snake bean, *Vigna unguiculata* ssp. *sesquipedalis*, in the Top End of the Northern Territory. Proceedings of the sixth workshop for tropical agricultural entomologists, Darwin. *DPI&F Technical Bulletin* No. 288, 95-100.

Zhang, L. (2008) biology and Pest Management of Spider Mites. Factsheet ENT-4. Department of Primary Industry and Resources, Northern Territory Government.

INFORMATION SHEET

VG15013 Improved Management options for Cucumber Green Mottle Mosaic Virus (CGMMV)

CGMMV AND EUROPEAN HONEY BEES: RESEARCH UPDATE - FEBRUARY 2018

Cucumber green mottle mosaic virus (CGMMV) is a plant disease which was exotic to Australia until September 2014.

There is strong evidence that honey bees can introduce CGMMV into clean cucurbit plants. Trials in Israel have shown that bees are able to transfer CGMMV from infected cucurbit plants to clean cucurbit plants in a shade house under specific conditions (Darzi et al 2017). Two honey bee field trials have been conducted in the Northern Territory and each time, CGMMV was found in the flowers but not the leaves thus suggesting an introduction by pollinators.

Hive products from the Northern Territory and Queensland have been tested for the presence and viability of CGMMV. All hive products (adult bees and brood, honey, pollen, empty cells, propolis) have been shown to contain CGMMV. Of those samples tested pollen, honey and adult bees have the highest prevalence of CGMMV. The viability of CGMMV in hive products has been tested. So far, viable virus (capable of causing infection in plants) has been isolated from pollen, honey and adult bees.

It is not known how long CGMMV remains viable inside bee hives. Viable samples of CGMMV have been collected from bee hives in the Northern

Territory and Queensland in 2017, but we suspect that the source of this virus is a recent reintroduction rather than the virus persisting over years. Pollen samples from hive product testing have been reserved for future work to determine what plant species the CGMMV is coming from.

The Hort Innovation VG15013 project team is currently finalising a sampling protocol for the detection of CGMMV in bee hives. It is likely that this protocol will recommend taking small samples (e.g. three bees, three pollen cells) from multiple hives within an apiary.

We do not understand how bees move CGMMV around in the environment. The crucial question is, can honey bees move live virus out of their hive to infect clean plants? This would present a significant risk if managed pollinators are exposed to the virus and then moved between locations. We are pursuing opportunities to continue this work.

Darzi, E., Smith, E., Shargil, D., Lachman, O., Ganot, L., & Dombrovsky, A. (2018). The honeybee *Apis mellifera* contributes to *Cucumber green mottle mosaic virus* spread via pollination. **Plant Pathology** 67(1) 244-251.

For further information please contact:

Project leader: Dr. Lucy Tran-Nguyen
Principal Molecular Scientist
Department of Primary Industry and Resources
E: lucy.tran-nguyen@nt.gov.au
P: 08 8999 2235



Management practices to minimise Cucumber Green Mottle Mosaic Virus in European honey bee hives

CGMMV AND BEE HIVES

Cucumber green mottle mosaic virus (CGMMV) is a plant disease that is found in cucurbits (e.g. watermelon, cucumber and pumpkin) and a number of common weed species.

Honey bees come into contact with CGMMV when collecting pollen and nectar through their regular foraging activities. Although live CGMMV has been identified in bee hives we have no evidence that CGMMV affects the health of bee hives. There is some evidence that bees are able to move CGMMV infective material from CGMMV positive plants to healthy plants and thus transmit the virus.

GOOD APIARY MANAGEMENT

Apiary management requires vigilance of the health of hives. Good biosecurity practices to ensure hive health include; regularly checking brood production and appearance, honey production and worker bee behaviour and appearance. Other practices that maintain hive hygiene include:

- quarantining and isolating new entrants to the apiary. For bee diseases this is typically 4-6 weeks
- clean all equipment between hives or loads of hives. If possible, have separate equipment between loads
- store equipment and consumables on the apiary in such a fashion that bees cannot access it
- hive components should only be interchangeable within a load
- honey supers should be separated at the extraction plant and not interchangeable between loads
- the extraction plant and hive equipment should be cleaned between loads to ensure all wax and honey debris is removed. Typically this is done using hot water or steam cleaning.

PRINCIPLES OF CGMMV MANAGEMENT

Successful apiary management practices minimise the introduction and possible spread of CGMMV within a beekeeping enterprise. Management practices aim to prevent or control the introduction of CGMMV into hives and increase the likelihood of being able to trace detections back to the source. A variety of management practises are used, and may involve separation of single hives, separation of loads of hives or even the separation of entire apiaries into distinct units.

The principles of apiary management are the same, no matter what type of management system you adopt. Principles of apiary management are:

- physical separation to prevent and minimise possible CGMMV spread, changing frames and spinning off honey immediately after a known exposure to CGMMV positive plants
- use of biosecurity practices to minimise the introduction of CGMMV e.g. not working crops known to be CGMMV positive and resting hives at 3-5km away from known CGMMV positive sites
- keeping concise and accurate records, to enable trace back to determine the source of a disease.

Specific management practices are context specific and can be developed to suit commercial or individual needs.



Management practices to minimise Cucumber Green Mottle Mosaic Virus (CGMMV) in European honey bee hives

MANAGEMENT PRACTICES

Management practices for CGMMV require the continuous implementation of biosecurity measures.



ENSURE:

- clear permanent marking and identification of hives (individually or in loads) and their components
- accurate and concise keeping of records for all apiary activities
- you have a clear understanding on the how management systems operate
- you understand how bees and hives are exposed to CGMMV
- a 3-5 km separation of possible CGMMV infected hives and CGMMV free hives
- hives that contain CGMMV are attended to last in the workflow, and that you use separate hive tools and bee keeping gear for these hives
- restrict movement of people, vehicles and animals to hives that you suspect contain CGMMV
- you do not neglect hives, or equipment associated with hives suspected to contain CGMMV. They may act as a reservoir
- the apiary and pollination sites are kept free from weeds that may act as reservoir hosts for CGMMV.

VISIT OUR WEBSITE FOR FURTHER INFORMATION

<https://nt.gov.au/industry/agriculture/food-crops-plants-and-quarantine/cucumber-green-mottle-mosaic-virus>

<https://dpir.nt.gov.au/primary-industry/primary-industry-strategies-projects-and-research/plant-industries-research>

If you have any questions, please contact the Exotic Plant Pest Hotline on 1800 084 881.

Non-hosts of Cucumber Green Mottle Mosaic Virus

Cucumber green mottle mosaic virus (CGMMV) is a plant disease that is found in cucurbits (e.g. watermelon, cucumber and pumpkin) and a number of common weed species. A range of vegetable species and cover crops have been identified as non-hosts of the virus.

Research on the survival of CGMMV in soil, free from host plants and weeds, has indicated that the virus can survive for at least 12 months. With this knowledge and in consultation from Northern Territory Farmers Association, a range of vegetable species and cover crops were selected for testing to identify whether they could be hosts of CGMMV. As there are two distinct seasons in the Northern Territory (NT), dry (d) and wet (w), crops for each of the seasons were investigated. These crops included; sweetcorn (d), snake bean (d), okra (w), capsicum (d), peanuts (w) and sorghum (w). Research identified that these crops are not hosts of the virus, nor do they harbour it for further spread. This may offer an alternative crop for affected growers in the NT and nationally.

Capsicum



Okra



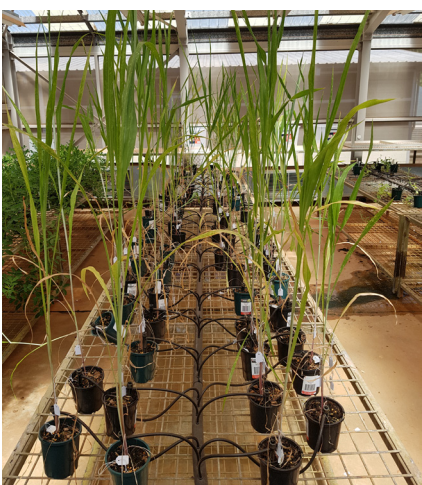
Peanuts



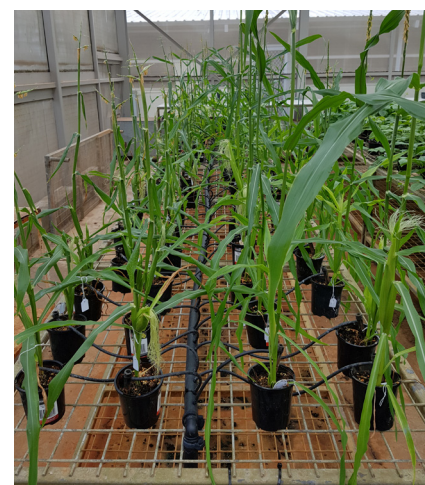
Snake bean



Sorghum



Sweetcorn



For further details, contact **Lucy Tran-Nguyen**, DPIR Principal Molecular Scientist on (08) 8999 2235

Symptoms of Cucumber Green Mottle Mosaic Virus

Cucumber green mottle mosaic virus (CGMMV) is a tobamovirus capable of infecting cucurbit, Asian vegetables and melon crops.

Identifying CGMMV within crops can be difficult early on as visual symptoms may not be observed until 2-6 weeks following infection. This is also dependent upon factors including; initial titre of the virus, temperature during infection and cultivar and species of host which can influence the level or load of symptomology.

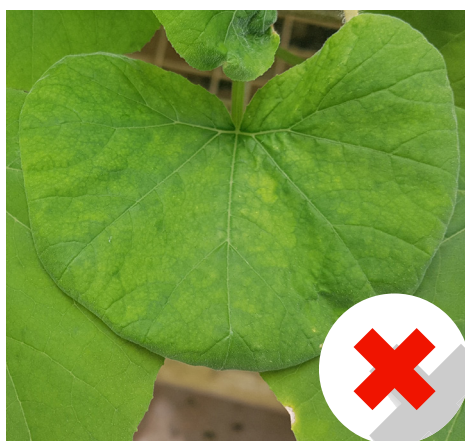
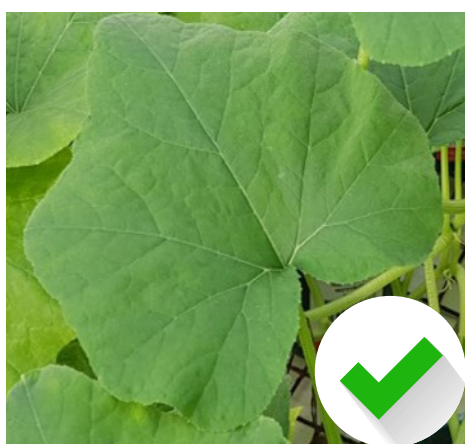
SYMPTOMS

Mosaic mottling of leaf material is the most common symptom in an infection and often the only symptom. This can be confused with Potyvirus, which also causes similar symptomology in the leaf material of cucurbits.

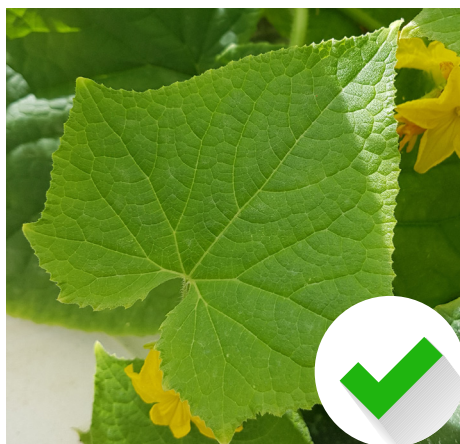
A consideration when looking for symptoms is whether the crops are grown in the ground and in the open, or in pots under shade structures. Within pots, the symptoms are often severe, with very detailed mottling, while in the field, symptoms in watermelon and pumpkin can vary from subtle to severe, often making it difficult to observe and distinguish between other diseases and nutritional problems.

Please see examples of healthy and infected plants below:

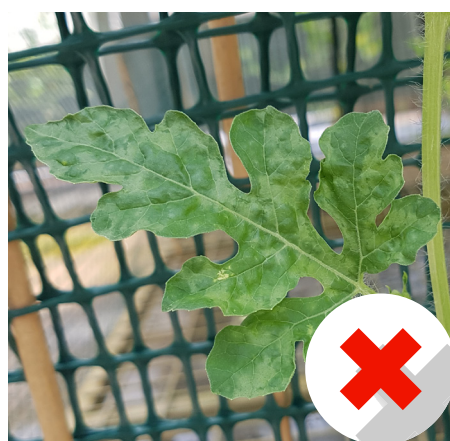
Pumpkin



Cucumber



Watermelon



INFORMATION SHEET

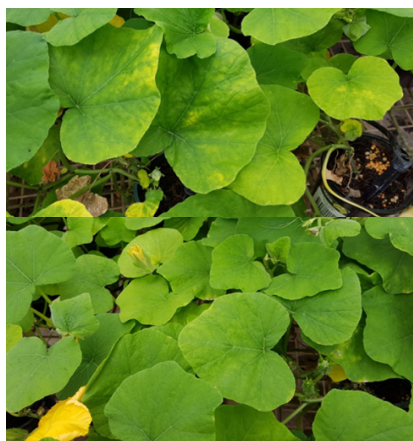
Symptoms of Cucumber Green Mottle Mosaic Virus (CGMMV)

VARYING SYMPTOMS

Three of the most common crops grown in the Northern Territory; watermelon, cucumber and pumpkin, show varying symptomology not only within each crop species but also between species. A consideration when looking for symptoms is whether the crops are grown in the ground and in the open, or in pots under shade structures.

Within pots, the symptoms are often severe, with very detailed mottling, while in the field, symptoms in watermelon and pumpkin can vary from subtle to severe, often making it difficult to observe and distinguish between other diseases and nutritional problems.

Pumpkin



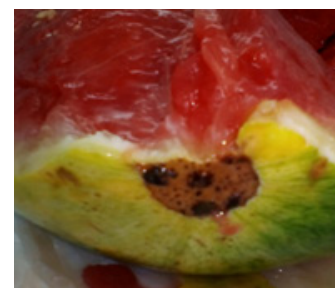
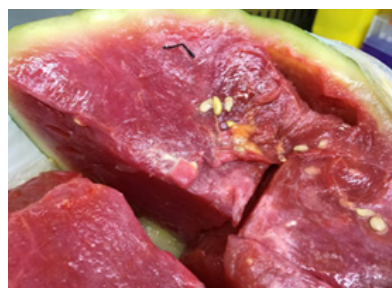
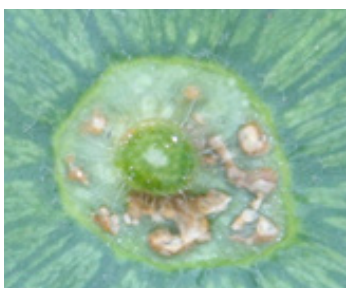
Watermelon



Cucumber



The fruits rarely show symptoms on the outside, however browning and lesions on the peduncle (stalk) has been noted. When an infected fruit is dissected, the internal structure is sponge like with a meat-like texture and is not suitable for market.



Above: examples of lesions on the watermelon peduncle

Above: examples of infected watermelon fruit

For further details, contact **Lucy Tran-Nguyen**, DPIR Principal Molecular Scientist on (08) 8999 2235

Weed hosts of Cucumber Green Mottle Mosaic Virus

Cucumber green mottle mosaic virus (CGMMV) is a plant disease that is found in cucurbits (e.g. watermelon, cucumber and pumpkin) and a number of common weed species.

A number of weeds and grasses have been identified as hosts of CGMMV following diagnostic surveys between 2015 and 2017. Weeds common to cucurbit growing areas have been opportunistically collected close to previously infested properties and tested for the virus. These surveys have detected the virus in weeds and grasses not tested before, indicating a potentially larger weed host range than first reported.

SUSPECTED WEED HOSTS OF CGMMV

From continued surveys conducted since the initial detections of CGMMV in the Northern Territory, a number of weeds and grasses have been identified as potential hosts. Unlike crop hosts, identified weeds and grasses are not reported to show any symptoms, making it more difficult to determine if CGMMV is present.

Weed species commonly found in cucurbit growing areas are currently being investigated further to determine if the selected weeds and grasses are true hosts of the virus and to identify if any host reactions are identifiable.

Common Name	Scientific Name
Amaranth	<i>Amaranthus viridis</i>
Black Nightshade	<i>Solanum nigrum</i>
Caltrop	<i>Tribulus terrestris</i>
Crowfoot Grass	<i>Eleusine indica</i>
Pigweed	<i>Portulaca oleracea</i>
Sabi Grass	<i>Urochloa mosambicensis</i>
Wild Gooseberry	<i>Physalis minima</i>



Amaranth



Black Nightshade



Caltrop



Pigweed



Sabi Grass



Wild Gooseberry

For further details, contact **Lucy Tran-Nguyen**, DPIR Principal Molecular Scientist on (08) 8999 2235

Narratives for VG15044

Narrative Tuan Dang NAQS survey

Date: December 5, 2016

Submitted: Greg Owens

Industry: Vegetable Industry

Issue: North Australian Quarantine Survey (NAQS) including commercial vegetable farms

Stakeholder: An Asian vegetable grower Tuan Dang, who has a mixed Asian vegetable and tropical fruit farm on 2 x 20ha adjacent blocks at Marrakai, NT. Tuan is a leading grower and industry champion in the Asian vegetable community in the Top End and has farmed in this area with his brother Hung Dang for 19 years.

Engagement: Tuan allowed the NAQS team to include his property in one of their periodic surveys of Northern Australia for exotic insects and weeds. Tuan engaged with the survey team on his farm and explained to the survey team his issues and practices with pests, and weeds. This is against a background where growers are very suspicious of any quarantine officer following multiple biosecurity incursions and farm closures in the immediate area.

Reaction: There was an excellent interchange of knowledge and practices with Tuan providing industry perspectives. The survey entomologists and botanists provided their expertise to identify some problem pests and disease and potential native beneficials while they were collecting samples for their exotic survey.

Actions: Tuan will allow the NAQS survey to revisit his farm on a regular basis to build their knowledge of the pest and weeds on commercial vegetable farms in the Top End which is a potential exotic incursion point. Tuan will increase his personal surveillance of his farm on some of the threats discussed during the visit and has a reporting mechanism to query unknown weeds and pests. During the survey a weed thought to be a host weed for CGMMV was correctly identified by the botanist as a similar but unrelated weed that is **not** a known host of CGMMV



Impacts: The initial impact is to improve relationships between a leading grower and quarantine survey officers and increase the knowledge of both parties of each other. The second impact is that the degree of management of the weed, thought to be a CGMMV host, is greatly reduced as the weed is not an identified threat to transfer the virus to the cucurbits grown on the farm. The larger potential is for a positive relationship between the NAQS survey team and growers that will improve the growing community surveillance of commercial production areas that will help safeguard the Top End industry.

Narrative: Vietnamese Growers IPM Demo site farm walk

Date: Thursday July 13 2017

Submitted: Samantha Tocknell

Industry: Vegetable Industry

Issue: Pest Management, Grower Engagement

Stakeholder: Vietnamese Growers of Asian vegetables.

Engagement: At the last field event, we had many RSVPs from growers but on the morning of the event, majority of the Vietnamese and Cambodian vegetable growers sent their apologies and were unable to attend. The project leader organised an informal farm walk at the IPM demo site, for those growers who were unable to attend the main event. This meeting was very successful, the growers were comfortable, enthusiastic and eager to participate.

Reaction: Growers revealed that the lack of attendance by Vietnamese farmers at the major events (typically Thursdays 10am – 2pm) was because although the day of the event was their “day off”, they often planned to go into town on Thursdays, in the morning and get caught up running errands. The growers explained that days off can become very busy and they are often not heading back toward their farms (and near the demo plot) until the afternoon. They expressed that they had wanted and intended to attend the event.

The growers appreciated that we cared whether they were there or not and were willing to alter the schedule of events to accommodate them. We explained that we did not mind in what format the project information gets to the growers, just if it does and they find it useful.

They were grateful for the opportunity to experience the farm walk at a mutually beneficial time. An informal evaluation discussion at the end of the field activities highlighted that this engagement style suited them far more than the formal events that draw larger crowds. The growers were extremely relaxed and open with their questions and comments. Quite a stark contrast when we compared to our observations of the same growers at large events.

A small group activity is far more effective with the Vietnamese growers because they all know each other and are a close community. Together they are not intimidated by others and bounce off each other well. When gathered together in small groups those Vietnamese growers with better English assist those who may not have good English. They discuss the topic amongst themselves to generate further questions and promote understanding; In this way, they learn more and this increases the likelihood of practice change toward best practice.

Actions: We will run the next major event on the same day of the week but later in the day to better accommodate these growers next time. However, intermittent events for small groups will now be a regular occurrence.

Impacts: The IPM demo site maintains a flexible program and is open for growers to explore with the project team between scheduled field events. The demonstration is responsive in nature, and aims to provide real benefit to growers, helping them tackle the types of issues they are currently dealing with.



Growers engaged in a farm walk and examination of common pests and beneficials under microscope.

Narrative: Vietnamese Growers Bio-security training Gregory Rd

Date: Thursday August 2016

Submitted: Greg Owens

Industry: Vegetable Industry

Issue: Bio-security, CGMMV, ON-Farm Biosecurity Plans

Stakeholder: Vietnamese Growers of Asian vegetables. Nha Pham, Sonny Vo

Engagement:

Reaction:



Impact:



Narrative: Vietnamese Growers adapt IPM and innovative pest management

Date: Thursday August 2016

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Industry: Vegetable Industry

Issue: IPM adoption

Stakeholder: Vietnamese Growers of Asian vegetables. Kevin Hoang

Engagement: Kevin Hoang is a young Vietnamese Asian vegetable grower in the Marrakai region.

He started growing okra on his property on Gregory Road in 2015. Kevin and his father had limited experience and knowledge when it came to growing vegetables in the Northern Territory. They relied heavily on the experienced farmers for advice. After two years of growing okra, the pest levels were increasing and the profit margins were decreasing, Kevin made a commitment to change his growing practices.

Reaction: Kevin approached NT Farmers Association for advice on how to increase production, minimise pests and have good quality fruit for market. The VegNet Industry Development Officer visited Kevin's property to coach him on industry best practices and introduced him to Integrated Pest Management. Kevin has also attended numerous field walks and pre-season meetings held at the Coastal Plains Demonstration plot to better his knowledge and to build on his success in Integrated Pest Management (IPM).

Impact: Since committing to change, Kevin has adapted several growing strategies to increase his yield and to minimise pest issues on his property. Kevin has designed and manufactured a new spraying boom to spray more rows at one time, minimise the use of chemicals and have maximum penetration. He is also using a range of softer chemicals to increase his beneficial bugs. Kevin is a front runner in innovation and IPM in the community. His success in the industry has attracted the attention of growers and the broader vegetable industry around Australia. Kevin is now an advocate for IPM and a valued member of NT Farmers Association.





Appendix 7

SOIL WEALTH DARWIN PROJECT

Introduction

The Soil Wealth initiative provides growers with best practice information via a network of demonstration sites and social media. Practices focus on building soil health, improving productivity and profitability. Under the NT Regional Landcare Facilitator project, Territory Natural Resource Management has formed new relationships with stakeholders within the horticulture industry operating across Australia.

Background & Motivation

The demonstration site was set up to showcase a number of organic approaches that are now considered to be best practice for the broader horticulture industry. Through ongoing engagement processes, growers have expressed a need for programs that address a range of issues including retaining carbon in the soil, the role of microbiology in soil function and soil borne disease, and managing pests and disease in an integrated manner.

Project Focus

The demonstration site focuses on three key activities:

- The benefits of different types of cover cropping
- The effects of row covers on pest management and crop health
- The use of biochar to address soil carbon deficiencies and water holding capacity

MAIN AREAS OF CONCERN

- Very sandy soils at the site have high leaching and low carbon and cation exchange capacity
- Low carbon and water holding capacity impacts on healthy biological populations
- Root development seems to be restricted to shallow regions relative to moisture and nutrients

The Darwin Soil Wealth site consists of five beds (100m x 5m) with each bed made up of three rows. Cowpea, mungbean and sorghum cover crops were planted in December 2015 to protect the soils from heavy rains and to suppress weeds. One Control bed was left unsown. Once cut and incorporated into the



Biomass estimates were calculated for each cover crop by cutting and weighing a 1m² section. The fresh weights were recorded and multiplied by the area of each bed (100 x 5 m) to give biomass weights.

COVERCROP BIOMASS

Sorghum: 3000 kgs / 500 m²

Cowpea: 1750 kgs / 500 m²

Mungbean: 1000 kgs / 500 m²



After the cover crops were incorporated a compost tea and molasses treatment was applied and biochar was added to half of the site at five tonnes/ha. With drip tape running along the rows, grey plastic mulch was used to cover each row and eggplant seedlings were planted approximately 60cm apart. Floating row covers (10 x 6 m) were placed over four of the sections.

Cover crops	No biochar	Biochar
Sorghum		Net
Cowpea		Net
Control		Net
Mungbean		Net
Sorghum		

SOIL WEALTH DARWIN PROJECT

Soil tests were undertaken in the Control bed prior to the cover crops being incorporated. Further soil tests will be taken later in the season and at the end of the season to look at the benefits of different types of cover cropping and the application of biochar.



Discussion

MAIN BENEFITS AIMED FOR

- Reduced irrigation requirements
- Improved nutrient retention
- Increased beneficial soil biology
- Improved nutrient cycling

Cover cropping was used to provide several benefits. In addition to suppressing weeds and reducing soil loss from heavy wet season rains, it is anticipated that the cow pea and mungbean crops will boost the nitrogen content of the soil, whilst the sorghum with its greater bulk will contribute more carbon to the soil.

The plants under the floating row covers will be assessed for crop health and yield quality. They will then be compared to the uncovered crop. It will be interesting to see the effects of the floating row covers on the plants. Beneficial insects play an important role in an organic system. Their exclusion may actually be detrimental to plant health and yield.

The application of biochar to the soil will hopefully address key issues of extreme soil carbon deficiencies present in Top End horticulture systems as well as provide a full range soil function benefits including improved water holding capacity and nutrient availability.

"It was great to see the site and we certainly learned a lot about horticulture in the NT. It almost feels like a different country, there are so many differences between here and our southern sites"

Dr Jenny Ekman (AHR)

Future Activities

Yield assessments will be undertaken across the different trial scenarios later in the season. Fruit from plants in each trial will be counted, weighed and graded as marketable or unmarketable.

A Facebook page has been established by the NT Regional Landcare Facilitator and will be promoted throughout the local industry as a means for growers to connect regularly with the progress of these practices. In addition, a series of farm walks will be hosted at the site so growers can view the practices in action and connect with key industry experts.



Acknowledgements

TNRM and the NT Regional Landcare Facilitator would like to thank David Boehme, Greg Owens (NT Farmers Association) and Applied Horticulture Research for their hard work and commitment to this project.

Soil Wealth is run by Applied Horticultural Research and RMCG, with funding from Horticulture Innovation Australia Limited.

The Regional Landcare Facilitator Programme is supported through funding from the Australian Government's National Landcare Programme.

FURTHER INFORMATION

Northern Territory Regional Landcare Facilitator

08 8972 3042 / caroline.biggs@territorynrm.org.au
www.territorynrm.org.au



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Case Study IPM adoption Darwin 2018

An Asian vegetable grower, Sonny Vo, who has a mixed Asian vegetable and tropical fruit farm on a 20ha block at Marrakai, NT. Sonny is an established grower and industry champion in the Asian vegetable community in the Top End and has farmed in this area for 16 years. Sonny is a member of the original farmers that moved to Marrakai in the late 1990's or early 2000's to access more land and water than was available in the Darwin peri-urban area.

Sonny was experiencing difficulty with chemical resistance in *Spodoptera* species (cluster caterpillars) in his vegetable crops, in particular on snake bean and okra. Sonny had received advice from local resellers to use broad spectrum insecticides and was not having any success with control of the caterpillars. He discussed his problem with a local business who approached NT Farmers with the issue. NT Farmers had established the IPM demo block at Coastal Plains research Station and were advocating the use of IPM to manage pests rather than a chemical only control program.

The caterpillars were out of control and Sonny was ready to try anything to reduce the problem as his cash flow was reduced to almost nothing and he was depending on the proceeds of the Wet Season okra crop to set up his main Dry Season vegetable program.



Photo 1 & 2 Cluster caterpillar out of control on okra after constant insecticide use

The local reseller who was trying to help growers in the area deal with the resistance issue ordered some beneficial insects *trichogramma*, a small parasitic wasp that attacks heliothis caterpillar eggs on the belief that the pest species was a heliothis type caterpillar. The relevant entomologists were on leave and the project officer assisted the release of these wasps on the commercial cards provided.

The release of the *trichogramma* was carried out using a technique to protect them from rain in the middle of the Wet on a 0.5ha section of the okra crop at Sonny's farm. Another 1.0ha section of okra, separated only by a farm road, continued to be managed by conventional techniques of regular sprays of broad spectrum insecticides. Sonny was instructed not to spray any insecticides on the treated block as it would kill the released parasites.



Photo 3&4 shows the release of the trichogramma wasps

The return of the NT DPIR entomologists from leave correctly identified the caterpillars as *Spodoptera* cluster caterpillars and that trichogramma was not able to parasitize their eggs masses and predicted that they would have no effect on the caterpillar population. The entomologists agreed to accompany the project leader and reseller to look at the area and provide any advice they could. NT DPIR and the VegNet project had had our first year of success with the demonstration plot at Coastal Plains Research Farm so we were confident we could provide some advice on reducing insect damage and reducing the reliance on broad spectrum insecticides.



Photo 5&6 Project leader, grower entomologists and reseller inspecting for pests and beneficials

What we found was completely amazing. The okra in the area that was not sprayed due to the release of the trichogramma was completely free of caterpillar damage and the team had to search for any *spodoptera* caterpillars. There was a massive increase in beneficial insects such as the Spiny Shouldered Shield Bug and Big-eyed bugs which we had never seen before in a vegetable crop. There were numerous hunting spiders and small frogs on every second plant. The removal of the broad spectrum insecticides had achieved complete control of *spodoptera* within 4 weeks with no insecticide application. The adjacent block still being sprayed with conventional herbicides was still totally infested with the cluster caterpillar and no beneficial insects or animals could be found.

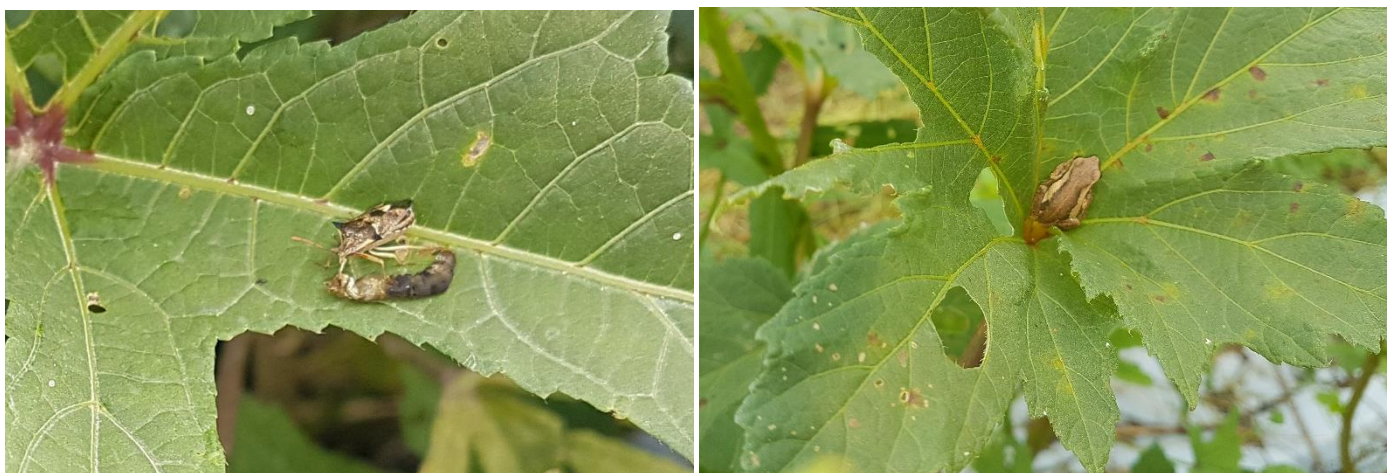


Photo 7 Spiny Shouldered Shield Bug devouring caterpillar Photo 8 Small frogs were found on most okra plants

The grower became a convert and from that outcome had the confidence to stop spraying broad spectrum chemicals on the other okra crops. He worked with the project officer and the NTDPIR entomologists to identify techniques and soft chemicals that could be used without harming the beneficials that removed the caterpillar issue and replaced it with an issue on how to pick and pack the great quantity of good okra he was now harvesting. He learnt to identify a range of beneficial insects in their adult and larva stages. Often the larval stages are better predators than the adults.

It reinforced the belief of the VegNet project and the NTDPIR entomologists that there were adequate beneficial insects and hunters in the environment that given a chance would manage a significant amount of the insect pests in the Top End vegetable crops. It increase the applicability of the monitoring at Coastal Plain demonstration plot and the production of insect calendars for these crops to assist farmers know what was coming and what was in the environment to deal with the pests.

The grower, who was already well respected and a source of local advice for other growers, became a champion for IPM in the area and now manages his crops to maximise the use of beneficials. A side benefit observed was if there is now a flare up of caterpillars the group 28 insecticides, such as Coragen®, which were rendered almost completely useless through selected resistance, now have impact on the spodoptera populations again. Group 28 insecticides are a key ingredient in a fully functional IPM program.

The time spent with the industry champion by the project and the NTDPIR officers has resulted in a many of the vegetable growers in the area adopting a much softer chemical and beneficial insect program with much greater success and improved business environmental and WHS outcomes.

Key Learnings:

- IPM can be implemented on small sections of NT vegetable farms
- IPM works quickly in the Top End if broad spectrum chemicals are excluded.
- Desperation can be a driver for change
- Technical support is vital for early adopters
- Industry, Government and farmer partnerships are critical for adoption of best practice.

Hort Innovation

This project has been funded by Hort Innovation, using the Vegetable Industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.



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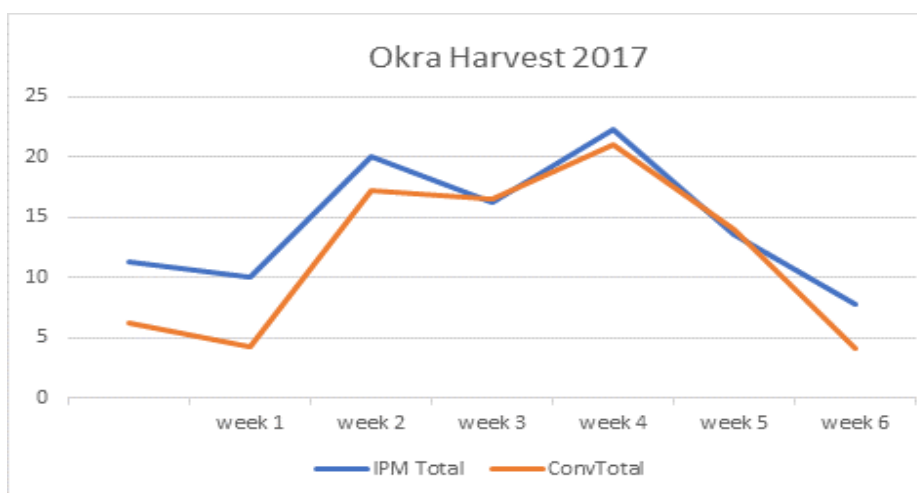
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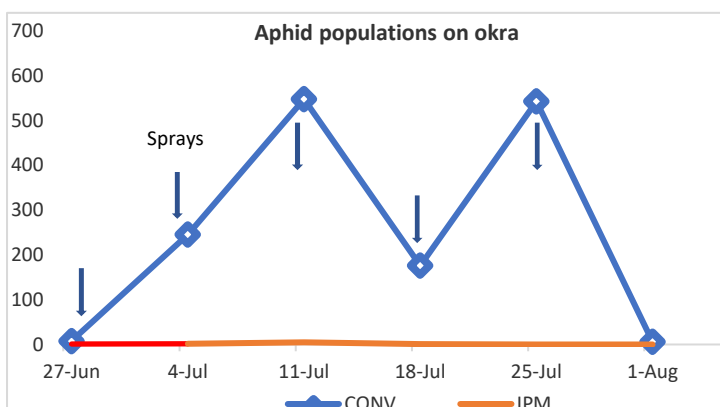
Coastal plains VegNet IPM Demo Block 2017

The first year of the Integrated Pest Management (IPM) demonstration block at Coastal Plains Research Farm with the cycle getting ready to start again. A wet season green manure crop of forage sorghum will be planted, where the vegetable crops were, as soon as weather permits. The harvest data collected indicated that there was a slight advantage in yield for the IPM Okra up until the end of the first set of production. Both the IPM and conventional block struggled with powdery mildew which reduced yield on both okra plantings. Each row was sampled weekly by entomologists from NT DPIR for a full range of pest and beneficial insects, spiders and mites.



Okra (kg)	IPM	Conventional	Difference	% Diff
Total	101	83	18	22%

The 22% increase in yield was mainly due to the more rapid early growth of the IPM okra rows which may have been an irrigation or fertigation effect. Next season the treatments will swap sides to check this. What was important was that there was no loss of production using IPM techniques.



The aphid population was the most notable difference between the IPM and conventional okra crops. The population of aphids in the IPM crop was always very low and so was the damage to the leaves. There was a range of aphid and general beneficial insect present on every

In the conventional block, the plants were sprayed weekly with registered insecticides for caterpillars and other pests. This resulted in a high aphid population and low numbers of beneficial insects and spiders.

In snake beans it was the 2-spotted mite that caused the greatest damage to the crop. These mites destroy the underside of the leaf when feeding. When in large numbers the leaves are severely damaged. These photos were taken one week before the end of the 2017 harvest. Note the conventional block of beans were almost completely leafless and had stopped producing. The IPM beans were still producing substantial crop and could have been harvested for another month as the predator mites and other beneficials kept the problem mite population in check.

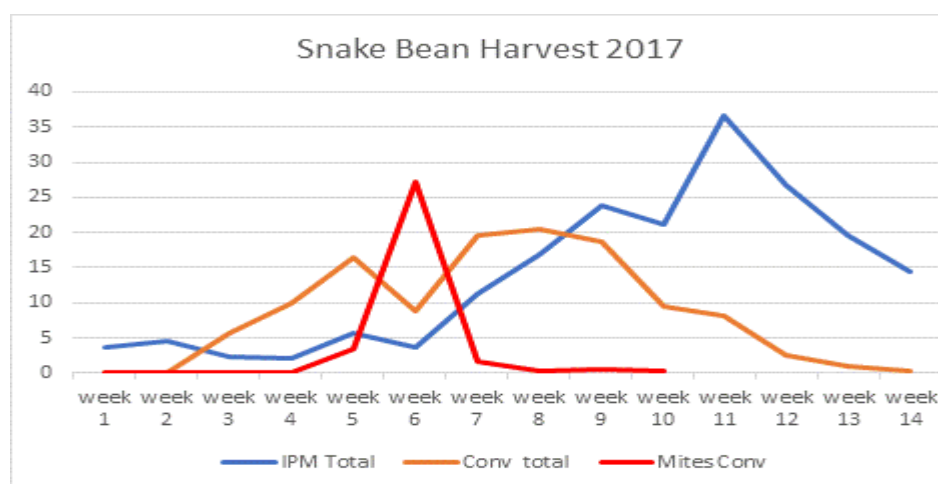


Figure 1 IPM snake beans 18 September 2017



Figure 2 Conventional snake beans 18 September 2017

This is seen in the harvest data below. The decline in production from the time the mite numbers exploded week 6 in the conventional block. The yields there decreased until week 13 when these rows could produce no more beans. Conventional miticides, like Arcamite, were applied but only slowed the eventual destruction of the conventional beans.



Snake beans (kg)	IPM	Conventional	Difference	% Diff
Total	193.20	121.6	71.60	59%

This almost 60% increase, or extra 72 kgs, in bean yield for the IPM treatment all came after the mites flushed on the conventional beans.

There are many more components to the IPM strategies that need to be addressed in 2018. The system needs to better control:- bean fly, green vegetable bug, mealy bug, nematodes and powdery mildew.

Thanks to our partners at NT DPIR Entomology and Coastal Plains Research farm and Territory NRM.

Check the VegNet calendar and NT Farmers e-news for next seasons field days and workshops. For more information contact your VegNet officer Laura Cunningham at NT Farmers on 08 8983 3233.

**Hort
Innovation**

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VG15044 VegNet IPM Demo Block 2018 Annual Report

Appendix 10

**Hort
Innovation**
Strategic levy investment

**VEGETABLE
FUND**

This project has been funded by Hort Innovation, using the Vegetable Industry research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

This Project is a Nationally Funded Program setup to effectively communicate vitally important research-based information to Australian Vegetable growers, provided through 10 regionally-based extension officers.

Project Code: VG15044: Regional capacity building to grow vegetable businesses in the NT

This project is funded by Horticulture Innovation Australia Limited and the Australian Government, using **Vegetable grower levies**. Hosted by NT Farmers Association (NTFA) to build on industry relationships through engagement-focused extension interactions with vegetable growers, assisted by stakeholder involvement to attain best practice change in the NT vegetable industry.

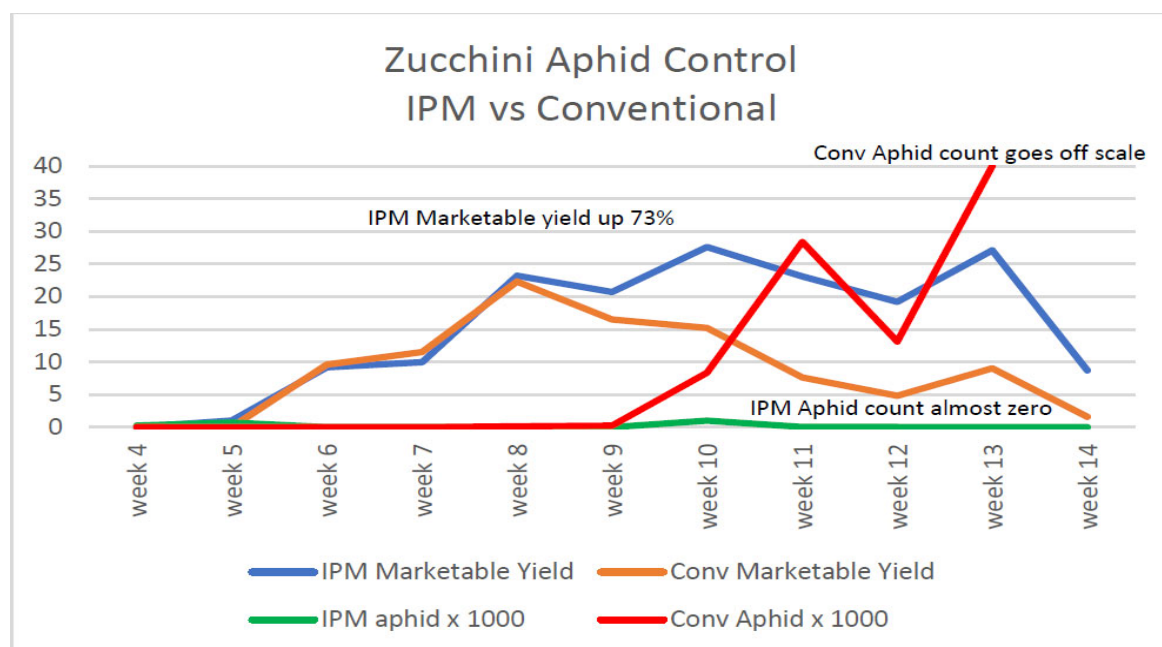
The aim is to consolidate NT grower business and agronomic models through addressing best practice gaps and capacity requirements, identified in relevant research conducted through implementation adapted to suit industry needs.

VegNet is delivering research-based information through the introduction of Integrated Pest Management, and/or encouraging establishment of IPM practices and strategies such as pest and disease management and best practice on-farm biosecurity management to minimise biosecurity incursions. All the while improving marketable yield quality for more profitable production of tropical vegetable crops in the NT. This work is being conducted in collaboration with NT Government Departments.

The IPM demo site at Coastal Plains Research Farm, located at Middle Point, close to growers for ease of access, continues to generate interest from new and existing growers. It provides crucial findings on best practice management of chemical resistant pests in vegetable crops predominantly grown by the Vietnamese and Cambodian growers in the NT.

IPM offers a range of alternative treatments and the targeted use of introduced beneficials and newer generation chemicals for these crops. Visual differences easily demonstrate greater profitability when using predatory bugs found naturally in their local environment against spraying of harder chemicals.

Development of IPM strategies for vegetable crops continues with pest monitoring by NT DPIR entomology staff on both the IPM and conventional plot, revealing the emergence of beneficial and pest species at different plant growth stages depending on weather conditions. Collection of total yield and marketable yield data on conventional vs IPM treated plantings provided hard data on the increase in profitability that can be achieved with this best practice approach.



VG15044 VegNet IPM Demo Block 2018 (page 2)

This information is captured in a crop calendar format and distributed to communicate grower pest issues in English and Vietnamese and has been invaluable in allowing engagement of non-English speaking growers.

Participation and support from stakeholders and the VegNet NT team is essential for uptake of Research, being achieved by engaged Vietnamese and Cambodian growers, wanting to transition more towards innovation and technology for more profitable production.

Industry champions (Farmers using best practice) are an integral part of the project's success, with on-farm monitoring and best practice techniques used throughout their vegetable growing season. Helping VegNet NT to expand the reach of the project to their communities to overcome communication barriers and convey the VegNet best practice strategies we could not otherwise manage without the aid of a translator.

Attendance at grower funded events was up 5% overall on previous years, notably due to a younger audience interacting with the VegNet NT project activities.

More regular monitoring will demonstrate outcomes resulting from information provided at field walks and workshops. The project's use of local trainers with the aid of translators, for delivery of activities allowing our Vietnamese and Cambodian growers to attend workshops which are crucial to best business and farming practices.

An end of year grower survey is conducted to determine the workplan for the following years project.

Continuation of the project over the next 3-5 years, will direct more energy towards the younger generation of farmers transitioning into the succession planning phase allowing them to learn through best practice change activities provided through the project.

Laura Cunningham





Using G-dots to check on Soil moisture

Laura Cunningham NT Farmers Assoc

The G-Dot system is a modern visual version of the G-Bug Soil Moisture Monitoring System. In these times when the water is going to be very precious it is a very useful tool to ensure that vegetable growers are using just the right amount of water for their irrigation.

It consists of a sensor block, cable and display unit. The sensor block fits into the end of a 20mm PVC pipe and can be cut to any length required.



G-Dot sensors should be installed at 20 cm and 50cm in a vegetable crop. This will show what the moisture levels are in the top and bottom of the root zones. It is a good idea to label the display units clearly.



The ideal soil moisture is for the top of the root-zone to have a high moisture content which is shown by all 6 yellow dots appearing on the 20cm display. The 50cm sensors should be registering just moist soil, 3 or 4 dots showing, which means some small amount of water and fertiliser is just making it to the bottom of the root-zone of most vegetables.

Small irrigations, at least 2 times a day is needed on sandy soils to achieve this. Heavier clay soils may only need an irrigation every couple of days once the soil is wet enough.

What that looks like on the G-Dot displays.



Too Wet down deep

The top of the root zone is showing 5 dots so is still damp but drying out a little.

The 50cm sensor is showing the deep soil is very damp which means a lot of water and fertiliser is going past the roots into the ground.

Irrigate more often with less water and check the reading after 2 days

Just Right

The soil in the top of the root-zone is quite damp with all 6 dots showing. The soil at 50cm is just slightly damp with 3 dots showing.

This means the irrigation water is just getting to the bottom of the root-zone, so the water and fertiliser are staying in the root-zone.

Keep this irrigation pattern and maintain the monitoring.



Too Dry, poor connection or a flat battery.

When the soil is completely dry no dots will show. This is because there is no conductivity in the sensor.

It could also be a poor or broken connection or a flat battery that needs to be checked. Place the sensor in a bucket of water for 10 mins to check. All 6 dots should show quite quickly.

If the sensor works, check your irrigation, it's not working!





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The Importance of Bio Refuge Barriers for IPM in the Top End

Greg Owens

Why in the NT are we spending so much time on our Banna grass windbreaks and bio-refuges?

Something I ask myself a lot when we're out in the heat of the NT wet season, with the humidity building just before a monsoonal down pour. Establishing the barrier grass is hot and sweaty work in the wet but the perfect weather for bugs to flourish.



Photo 1. Banna Grass established as cuttings Photo 2 Bana grass forms a dense 3-4m stand

But what we've learnt thus far, is these refuges are an essential part of our Integrated Pest Management (IPM) program in more ways than one. Bio-refuges are the critical link in the chain to the IPM program being developed by VegNet NT. Often the crops are grown in fully cleared paddocks that have no permanent diverse vegetation nearby to act as a source or home to beneficial organisms.

Providing a functioning eco system in a meter-wide row, gives sanctuary that allows the beneficial bugs and general predators, like spiders and frogs, to flourish. What VegNet has found is that the NT already has a wide range of beneficial organisms in the environment.

The trick is to have enough of them in close proximity to the crop when they are needed. Hoverfly and Ladybirds are an excellent example of this. They build up in numbers on the maize aphid, that is not a pest of most vegetables, but are found in these tropical grasses.

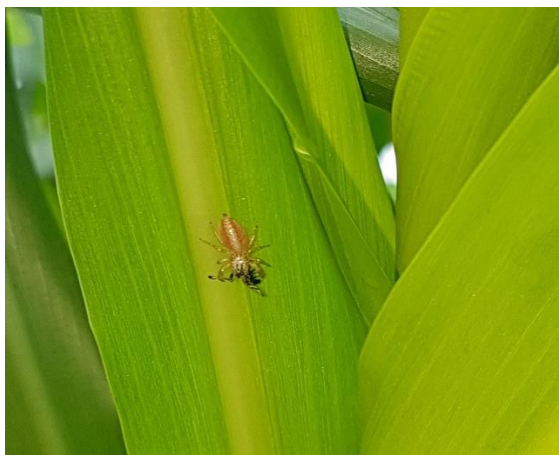


Photo 3. Predator spider in the Banna grass

These predators are then present in substantial numbers when other pest aphids try to establish themselves in the vegetable crops. The barrier grass row serves as a filter where the windborne pests land and a majority are taken out by these beneficial bugs before they can have any substantial impact on the crop being grown.

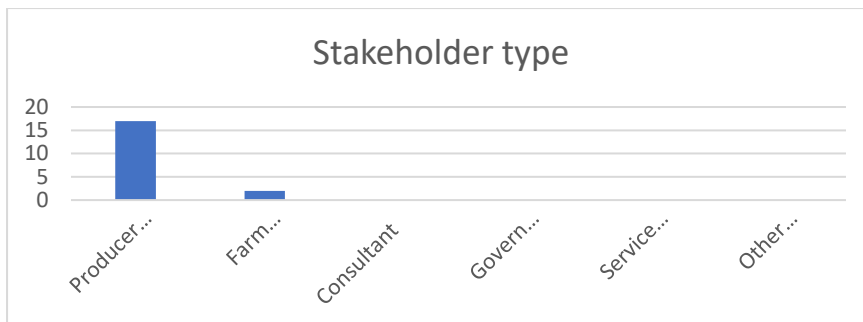
The Banna grass has other benefits as a wind break, reducing wind damage and evapotranspiration from the Dry South Easterlies that blow through the Top End growing season. They protect against over spraying from other crops nearby and spray drift also carried by the wind from neighbouring properties.

Why Banna grass? Because it's very easy to establish. To produce runners just add water, it'll shoot from any of the nodes. Management once established is relatively low, just slash beside it and run a mower over the row at 50cm once a year to maintain ideal height. The seeds are non-viable so even though it produces many seeds it doesn't become a weed problem. It grows just as vigorously as most of our weeds do in the Top End and the torrential Monsoonal down-pours don't hold it back.

The hardest argument of all is to convince farmers that these rows of tall, sometimes a little untidy, cane grasses are not a cost or a waste of space, but a critical tool in best practice management for the Top End vegetable farming.

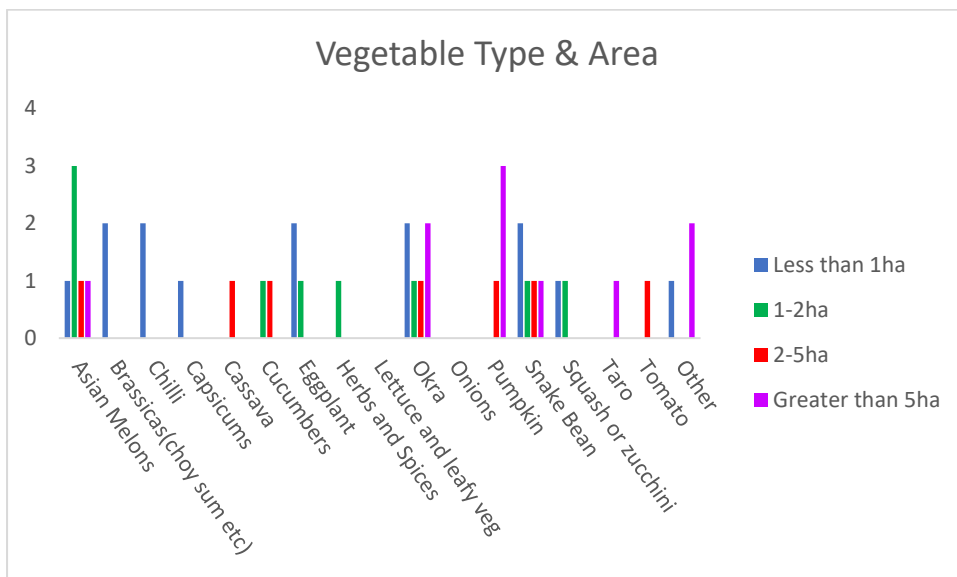
2017 VegNet grower survey results

Q1. Stakeholder type



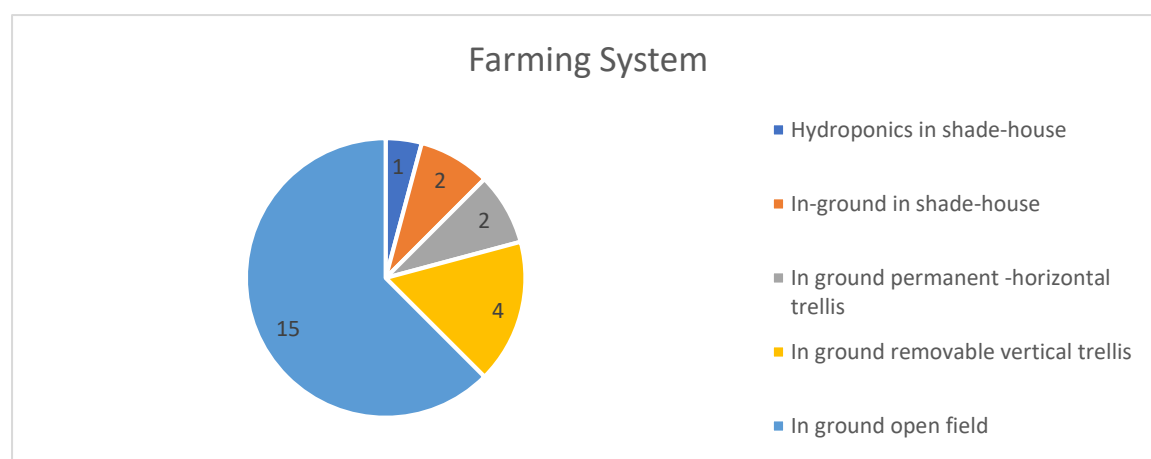
19 vegetable farmers completed the survey with 17 identifying as producer/managers and 2 as farm employees. A follow up email survey of Government and Industry stakeholders will be completed in the New Year.

Q2 What type of vegetable and what area is in production?



The 19 farmers covered the expected range of vegetables grown in the Top End. Non-levy vegetables like onions and tomatoes are important for biosecurity considerations and were added to the survey. Asian melons, cucumber, okra, snake beans and pumpkin were the major crops identified.

Q3 What type of farming system is used?



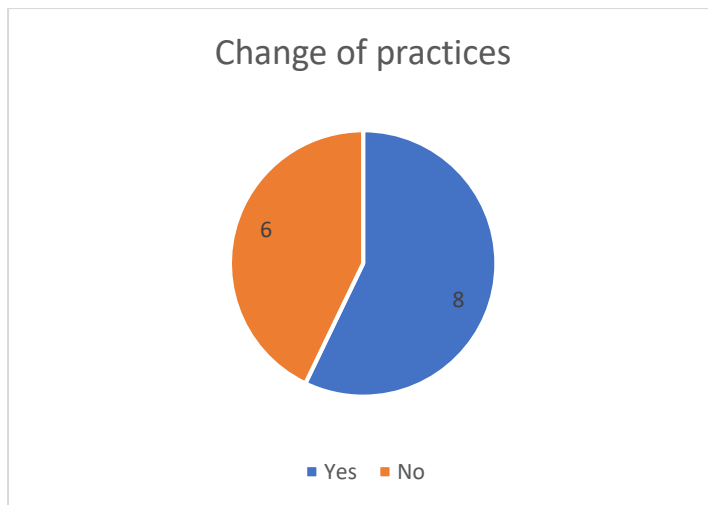
Most of the crops of the 19 responders are grown in open fields which would cover crops like okra, pumpkin, herbs, eggplant, zucchini. The vertical and horizontal trellises are used for snake bean and Asia melons respectively. The shade house and hydroponic systems are used for high value cucumber crops.

Q4 What type of event did you attend and how useful was it to your business?

	Low			Usefulness				High			
Vegetable Info Days Attendance & Usefulness	0	1	2	3	4	5	6	7	8	9	10
<input type="checkbox"/> Vegetable workshops			1		1	2	1	1			
<input type="checkbox"/> Vegetable IPM field day							1	3	2		1
<input type="checkbox"/> Soil Wealth field day									1		
<input type="checkbox"/> Innovation group meetings											
<input type="checkbox"/> Facebook page						1	1	1			
<input type="checkbox"/> SMS alerts						1		1			
<input type="checkbox"/> E-newsletter					2	2		2		1	
<input type="checkbox"/> Reports and notes									1		3
<input type="checkbox"/> One-one farm visit							2	1	1	1	1
<input type="checkbox"/> Other:						1					
CGMMV Biosecurity working group									1		

Comment: Of the 19-people surveyed its evident that the field days, workshops and media releases have been very well received with growers who attended revealing these activities have been useful to them and their businesses

Q5 have you changed your practices?



Comment

8 of the 19 farmers identified they had changed their practices and comments included

- 1 Chemical & Fertiliser uses
- 2 Chemical Storage
IPM give me ideas for pest control and more effective
- 3 spraying
Stopped Spraying & beneficials
- 4 controlled caterpillars
Applied Biochar to eggplant crop
- 5 on soil wealth site
Already using IPM but change to
- 6 biosecurity practices
Implemented IPM release of
- 7 Trichogramma
- 8 Full IPM program

This is a very encouraging result, all 8 referenced pest management changes which would indicate that the workshops, field days, farm visits and media are getting the message to the farmers to adopt better practices

Q6 If Yes how much sooner did you make changes as a result of the project information and activities than you would have otherwise done

- Sooner than I would otherwise
- 1 have done so
- 2 I don't expect to make changes
- 3 Did it straight away
- Always trying to improve the soil
- 4 health
- 5 Because of CGMMV
- Started in wet season 2016 as it
- was needed to control
- 6 caterpillars

Comment: Of the 19-people surveyed 5 ticked that they made changes sooner than they otherwise would have done

Q7 Overall, what project activity information or related information was most influential in making changes

- Farm Visits and inspection of
- produce from others regarding
- 1 chemical use
- 2 Advise from Muirs
- 3 IPM
- Farm visit by NTFA & DPIR
- 4 Entomologists
- Trail design with TNRM and NTFA
- 5 Veg Project
- Info about CGMMV and how to stop
- 6 it coming onto my farm
- Pak Solutions & NTFA assisted me to
- 7 implement IPM
- 8 Field studies & trials

Comment: From the information provided by the 19-people surveyed. Farms visits and field assistance, studies and trails conducted have been the most influential approach to conveying the project message for change

Q8 What other sources of information or support assisted you with changes

- 1 Assistance from Friends in Asian community
- 2 Less damage on crops due to insects & pests
- 3 David Hoseason-Smith RAC Rural Pac Solutions David give lots of
- 4 advice on bio-chem spraying
- 5 Pest & Disease Handbook
- 6 Organic & Biodynamic groups network , Biochar conference, Uni
- 7 NSW research project
- 8 NT Farmers, NT DPIR quarantine
- 9 The NT DPIR staff came to check the type of Mealy bugs
- 10 Workshops

Comments: Other sources used for information from the 19-surveyed showed that industry collaborators associated with the project were contacted for further assistance

Q9 If changes have been made on farm what benefits or impacts has or will this have on your enterprise-or do you expect it to have

- 1 No change
- 2 Farm biosecurity in place
- 3 Will reduce the risk of infection of viruses or diseases in melon and pumpkin crops
- 4 Trouble finding workers
- 5 Snake Bean prices have been low
- 6 Unknown
- 7 Good season /Profitable
- 8 Better insect control, less heavy chemicals, better payback
- 9 Got caterpillars under control now just use dipel & coragen
- 10 The soil benefits are not yet apparent. Expect high yields & lower disease in the crops
- 11 Kept the farm operating and disease free
- 12 Reduced caterpillar damage and reduced the number of sprays of caterpillars
- 13 Getting out of Veg production labour intensive

- Less chemicals, environmental
- 14 benefits

Comment: Feedback from this question show the projects ability to build awareness through IPM engagement strategy's

Q10 What has stopped you or made it difficult to make changes

- Being too busy to attend
- 1 information & field days
- 2 Language Barriers
- Less production this season affecting
- 3 income
- 4 No Difficulties
- Nil was just not aware of other
- 5 options
- 6 Everyone over spraying
- Other bugs like Mealy bug cause
- 7 problems with Okra
- Magpie geese pulled out the crop so
- changed to Kakadu plum collection
- 8 & processing
- Still have problems with other insect
- pests like mites on the snake bean
- 9 and mealy bugs in okra
- Labour, Cost of production and sale
- 10 price

Comment: The survey results show that of the 19-people, existing and evolving issues are presenting difficulties

Q11 What further information or assistance would help you make further changes to your management

- 1 Interpreter access
- Wants a contact number to call for
- 2 future assistances
- Happy for now if any
- problems/issues will contact and ask
- 3 for assistance
- How to get rid of Mealy bugs
- 4 without harming beneficials
- Need time & resources to continue
- 5 experiment.
- Need to work on export of veg to
- 6 Singapore and Hong Kong

How to stop mealy bugs & mites
without killing my beneficials.
Powdery mildew is a problem on
7 okra

Comment: Of the 19-people surveyed 6 of those suggested further information and assistance is required to make changes through access to contacts for continued capacity, communication & learning practises

Q12 Please make any other comments about the project activities or information, emerging issues or future needs

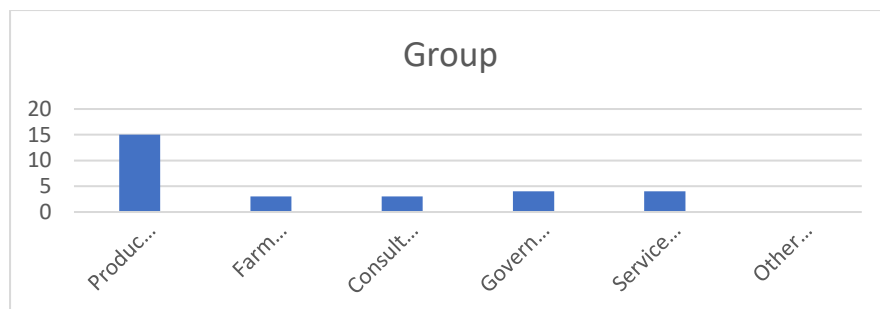
A lot of Asian farmers go to people
within their community for advice
1 due to language barriers
Need to keep working on what to do
2 when other pests are a problem
Soil in NT needs constant care with
green manure or mulch to add
carbon. Biochar is longer term and
will provide longer benefits. Need
3 for Veg project to continue this work
Cucumber prices are very variable,
4 export could stabilize prices
Need to develop more strategies
and options to control pest and
5 diseases
6 Keep it up

Comment: Of the 19-people surveyed it's been strongly suggested that more R&D is required with the support of the Demo plot and IPM with existing and emerging issues evident

Appendix 14

2018 VegNet grower survey results

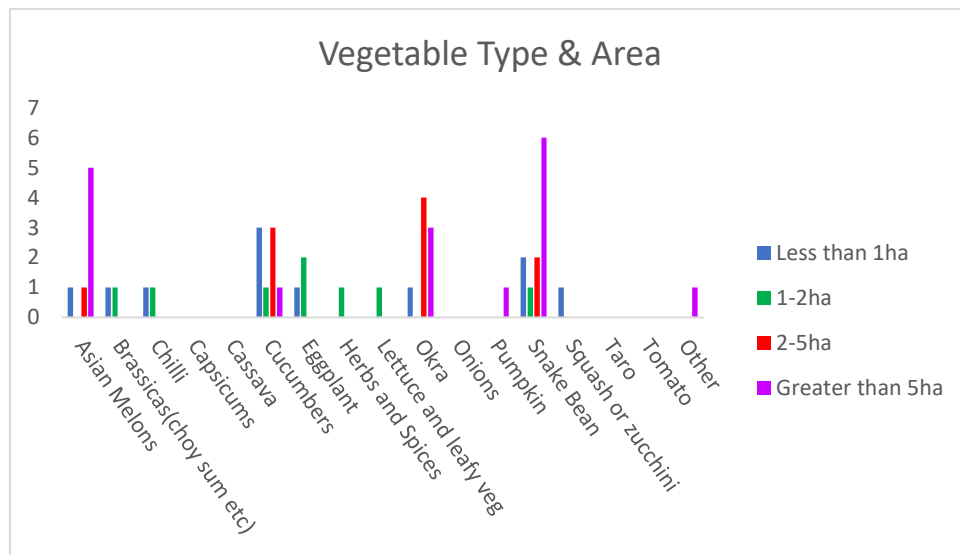
Q1. Stakeholder type



	Group
Producer/Manager	15
Farm employee	3
Consultant	3
Government employee	4
Service provider	4
Other (Please describe)	0

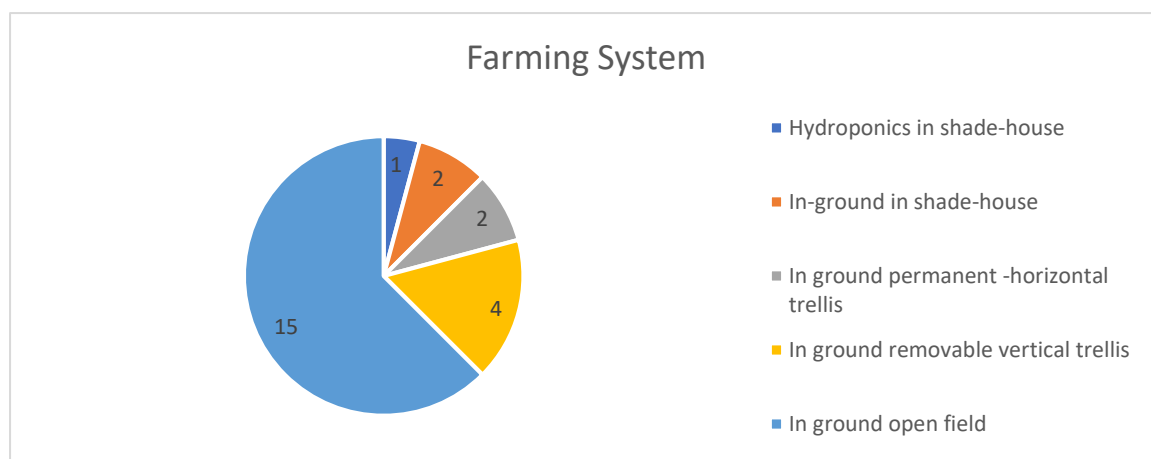
18 vegetable farmers completed the survey with 15 identifying as producer/managers and 3 as farm employees, 4 Government and 7 Industry stakeholders.

Q2 What type of vegetable and what area is in production?



The 18 farmers again covered the expected range of vegetables grown in the Top End. Asian melons, cucumber, okra, snake beans and pumpkin were the major crops identified.

Q3 What type of farming system is used?



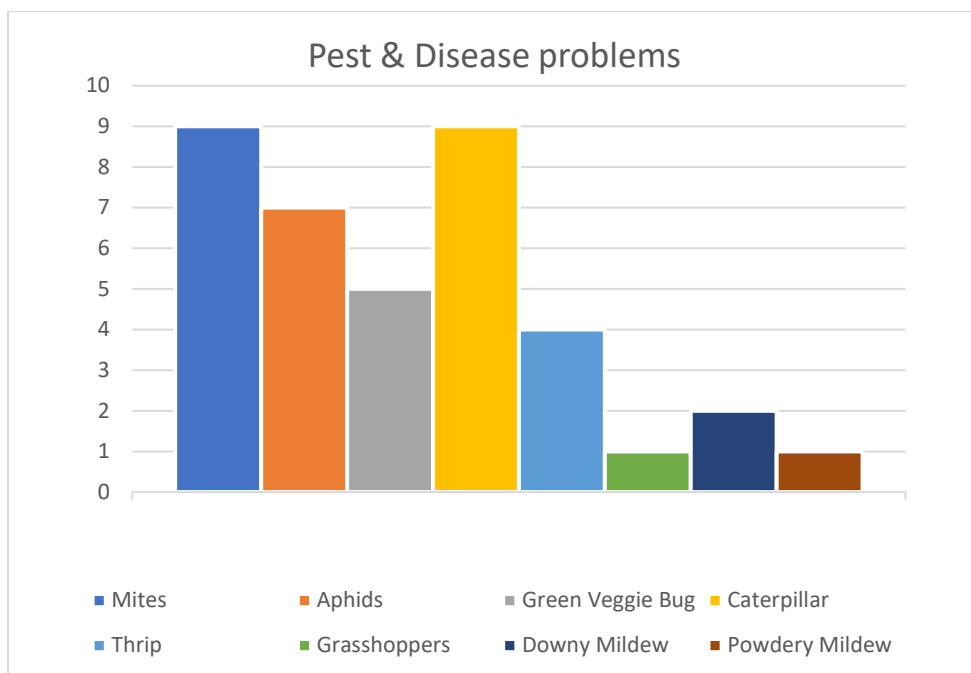
Most of the crops of the 18 growers are grown in open fields which would cover crops like okra, pumpkin, herbs, eggplant, zucchini. The vertical and horizontal trellises are used for snake bean and Asia melons respectively. The shade house and hydroponic systems are used for high value cucumber crops. The total number of systems at 24 indicates more than one system grown on a farm.

Q4 What type of event did you attend and how useful was it to your business?

	Low			Usefulness				High			
Vegetable Info Days Attendance & Usefulness	0	1	2	3	4	5	6	7	8	9	10
<input type="checkbox"/> Vegetable workshops			1		1	4	1	3			
<input type="checkbox"/> Vegetable IPM field day						2	3	8	2		1
<input type="checkbox"/> Soil Wealth field day					1	1			1		
<input type="checkbox"/> Innovation group meetings											
<input type="checkbox"/> Facebook page						1	1	4	2		
<input type="checkbox"/> SMS alerts						1		1			
<input type="checkbox"/> E-newsletter					2	2	6	2		1	
<input type="checkbox"/> Reports and notes						1		3	1		3
<input type="checkbox"/> One-one farm visit							2	6	7	1	1
<input type="checkbox"/> Other:						1					

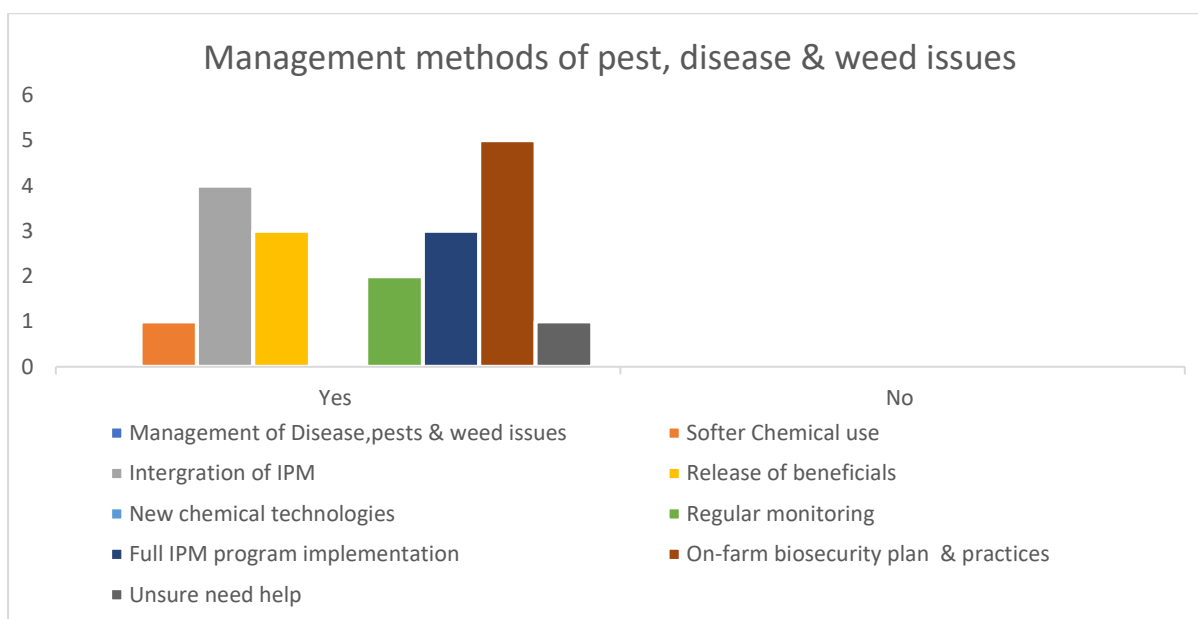
Comment: Of the 29 people surveyed its evident that the field days, workshops and enews have been very well received with growers who attended revealing these activities have been useful to them and their businesses. Growers still value face to face farm visits.

Q5 What are your major Pest or disease problems? You may select more than one.+



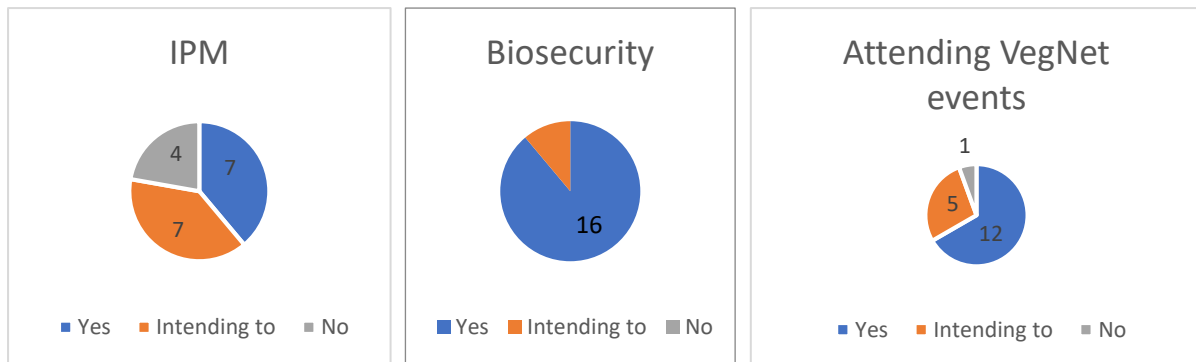
Mites and Caterpillars continue to be the main issues. Resistance is becoming a large problem for most growers using broad spectrum insecticides.

Q6 What management strategies are you currently using.



This result shows some of the growers are starting to adopt IPM practices but still need help to adopt full implementation

Q7 Have you changed your practices?



Comment

7 of the 18 farmers identified they had changed their IPM practices and 7 more intending to which is very encouraging. Biosecurity changes were very evident due to the CGMMV interstate and most farmers commented they would be attending more VegNet activities.

This is a very encouraging result, all 7 referenced pest management changes which would indicate that the workshops, field days, farm visits and media are getting the message to the farmers to adopt better practices. Of the 18 growers surveyed 5 ticked that they made changes sooner than they otherwise would have done

Q8 What other sources of information or support assisted you with changes

Comments: Other sources used for information from the 19-surveyed showed that industry collaborators associated with the project were contacted for further assistance

1. Assistance from Friends in Asian community
2. Less damage on crops due to insects & pests
3. Resellers
4. Pac Solutions give lots of advice on bio-chem spraying
5. Pest & Disease Handbook
6. Organic & Biodynamic groups network
7. NT Farmers, NT DPIR quarantine
8. The NT DPIR staff came to check the type of Mealy bugs
9. Workshops

Q9 If changes have been made on farm what benefits or impacts has or will this have on your enterprise-or do you expect it to have?

1. Reduced caterpillar damage and reduced the number of sprays of caterpillars
2. Can trade interstate with farm biosecurity in place
3. Will reduce diseases in bitter melon
4. Snake Bean prices have been poor, so more production needed
5. Better insect control, less heavy chemicals, better payback
6. Got caterpillars under control now just use dipel & coragen
- 7.
8. The soil benefits are not yet apparent. Expect high yields & lower disease in the crops
9. Kept the farm operating and disease free
10. Less chemicals, environmental benefits

Comment: Feedback from this question show the projects ability to build awareness and change knowledge & skills through IPM engagement strategy's

Q10 What has stopped you or made it difficult to make changes

1. Labour, Cost of production and sale price
2. Cost of softer chemical
3. Too hard to get bugs fresh, sometimes they are dead
4. Need to see more young stages of beneficial insects,
5. Timing of soft chemicals is harder to kill pests
6. Too busy to attend information & field days
7. Language Barriers, need interpreter
8. Not aware of other options
9. Still have problems with other insect pests like mites on the snake bean and mealy bugs in okra
10. Other bugs like Mealy bug and GVB cause problems with Okra when the caterpillars are gone

Comment: The survey results show that of the 18 farmers, existing and evolving issues are still presenting difficulties. Of the 28 people surveyed 20 of those suggested further information and assistance is required to make changes through access to contacts for continued capacity, communication & learning practises

Q12 Please make any other comments about the project activities or information, emerging issues or future needs

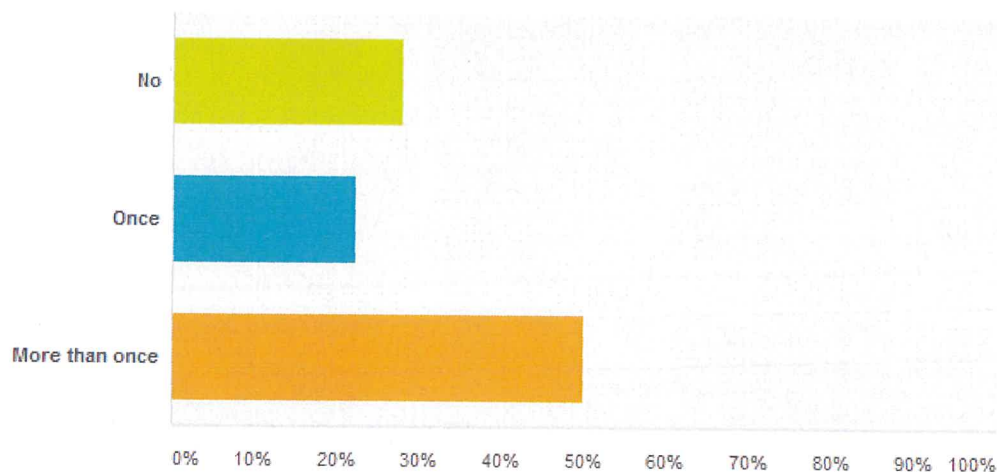
1. Provide leading Asian farmers with good information so when they go to people within their community for advice due to language barriers, they get good advice.
2. Other pests are a problem when caterpillars and mites are gone
3. Need to keep working on soil health in the tropics
4. Export could stabilize prices for vegetables
5. Need to develop more strategies and options to control pest and diseases not just caterpillars and mites
6. Keep up the good work

Comment: Of the 28 people surveyed it's been strongly suggested that more R&D is required with the support of the Demo plot and IPM with existing and emerging issues evident

CGMMV Pre-Meeting Survey Results as of 14 Dec. 16

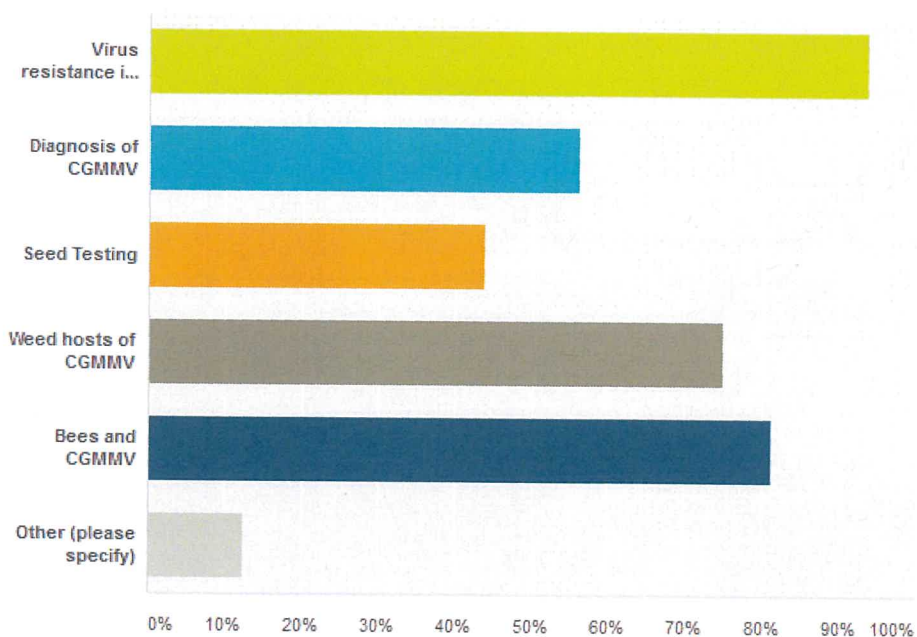
Have you been to previous CGMMV industry meetings?

Answered: 18 Skipped: 0



What do you want to know about, from the CGMMV Research Project?

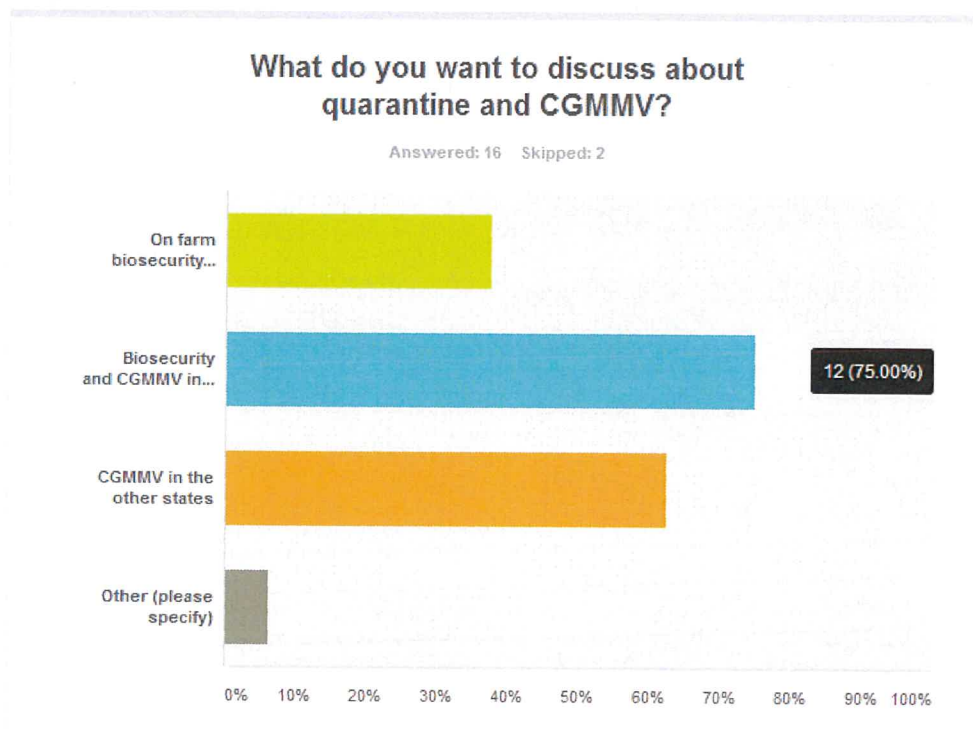
Answered: 16 Skipped: 2



Other:

All research work that is being carried out.

Transmission by wallabies and birds like geese and bustards.



Other:

Are there surveys still going on in the other states?

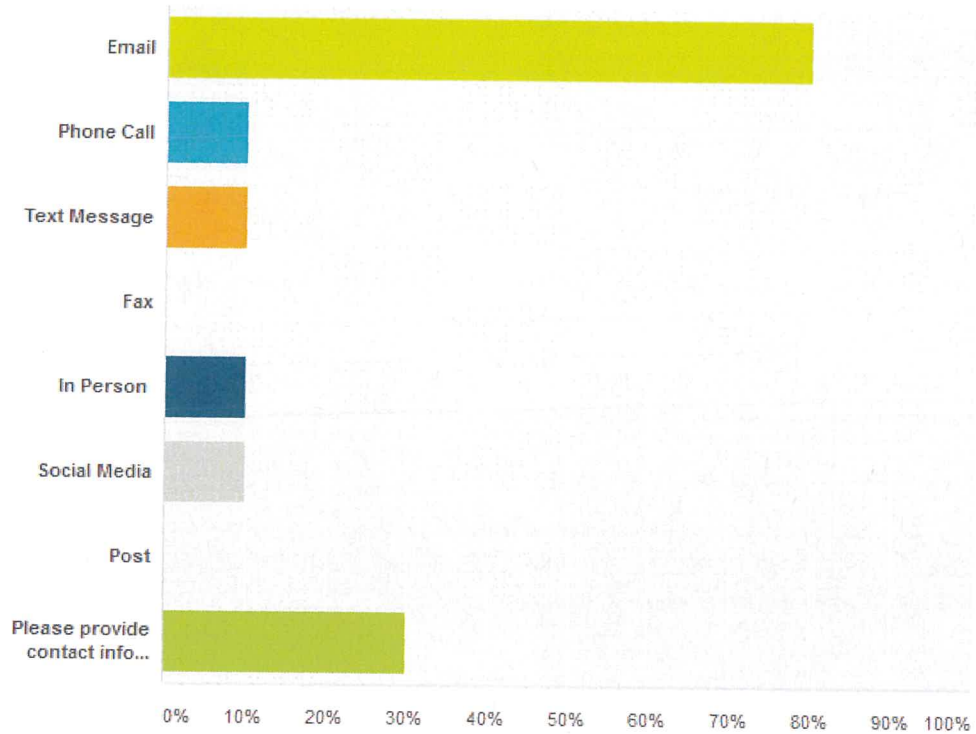
What else do you want to discuss at the Katherine CGMMV Meeting (on 15 December from 10:30am at KRS)?

Answered: 3 Skipped: 15

1. CGMMV and soil health issues
2. What further RD&E producers require
3. What happened in the market in 2016. Were there any infected melons or veggies found with CGMMV?

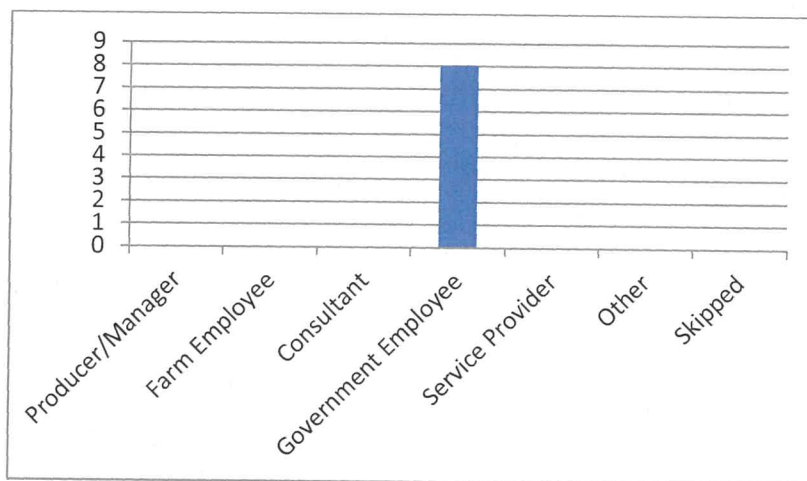
**If you are not coming to the meeting, what
is the best way we can get information on
CGMMV to you?**

Answered: 10 Skipped: 8



CGMMV Workshop 2017 Evaluation summary

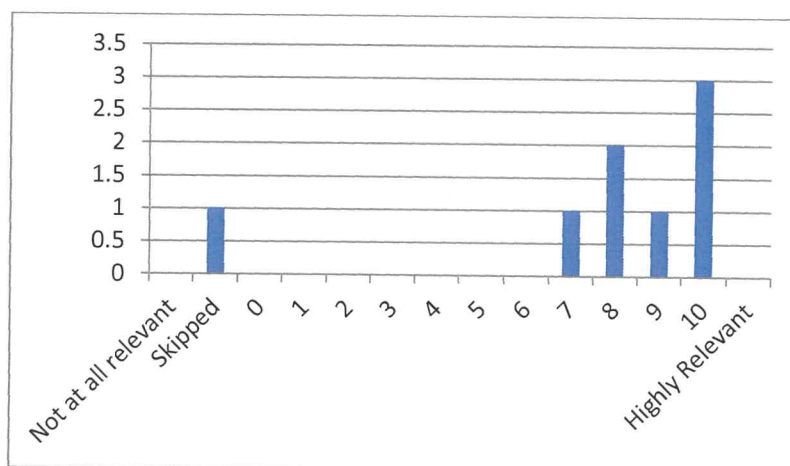
1. Which group best describes your role?



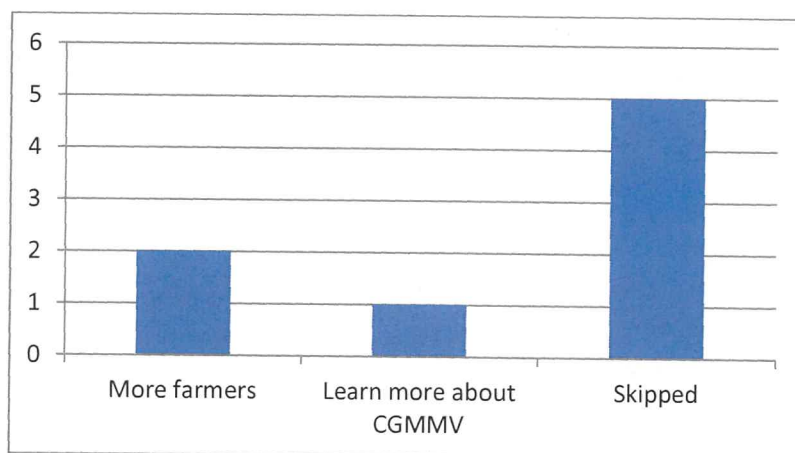
2. If a producer, please note the type of crop you grow and the number of hectares you use to grow these crops?

All: Skipped or Not applicable

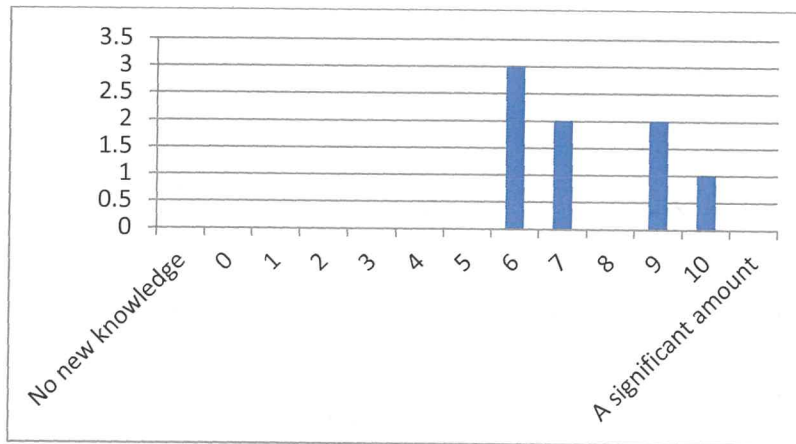
3. Overall, how relevant would you rate the meeting to you and your enterprise?



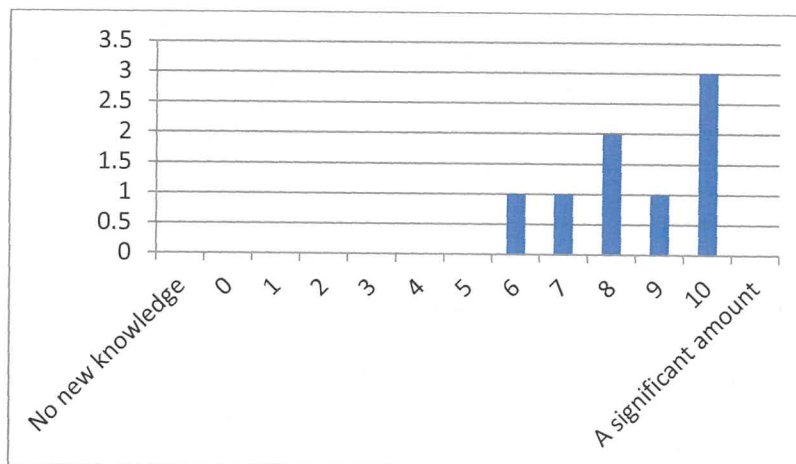
4. What would have made the meeting more beneficial to you?



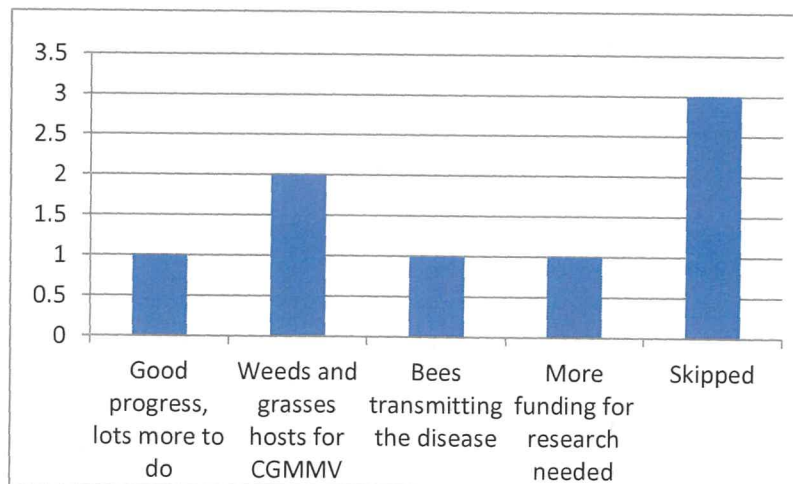
5. At the meeting what level of new knowledge or understanding did you gain about the **biosecurity situation for CGMMV**?



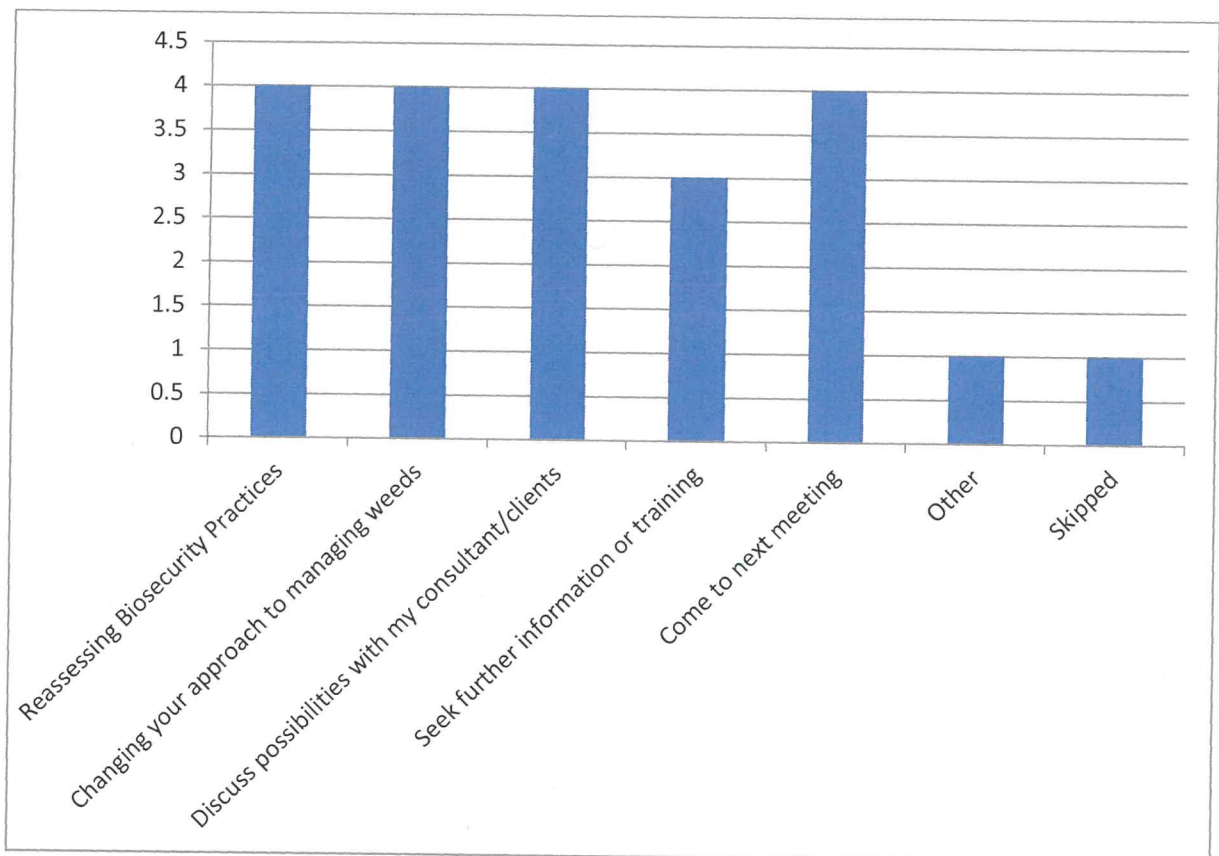
6. At the meeting what level of new knowledge or understanding did you gain about the results of **current R&D in CGMMV**?



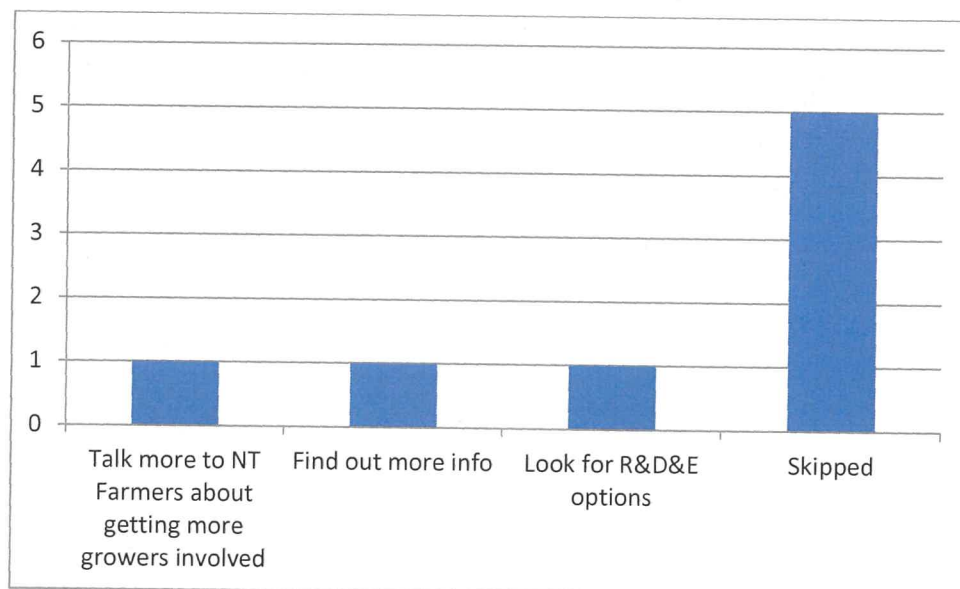
7. What is the key message that you are taking away from the event?



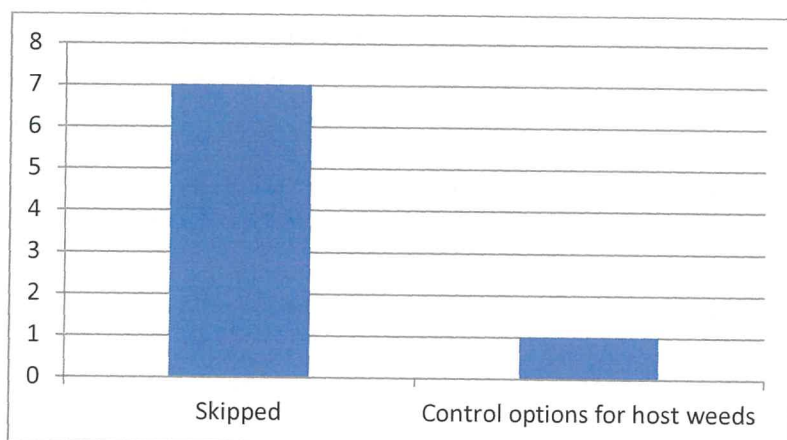
8. As a result of what you have heard at the meeting today, what action/s (if any) will you make?



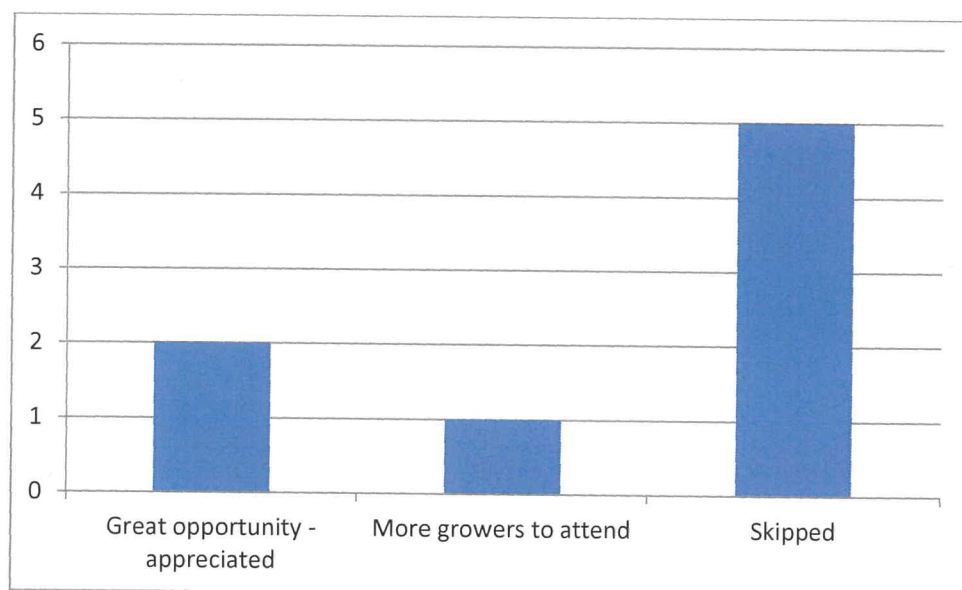
9. Please give details of what you are planning to follow up and/or take actions on.



1. Please indicate what other information or assistance you might need to act on the information you have gained.



2. Please make any other comments or suggestions about the event and its management.



14 Attendees

Sarah Cocoran
 Jetheth Lammon
 David Hamilton
 Lucy Tran-Nguyen
 Rod Freeman
 Chris Cronin
 Callen Thompson
 Sam Tocknell
 Vicki Simlesa
 Di Renfree
 Tony Asis
 Mila Bristow
 Greg Owens
 Ian Biggs

Appendix 4: Summary and Analysis of surveys and feedback from VG15044 events.

1. Summary: Soil Wealth Darwin Farm walk – 18 August 2016

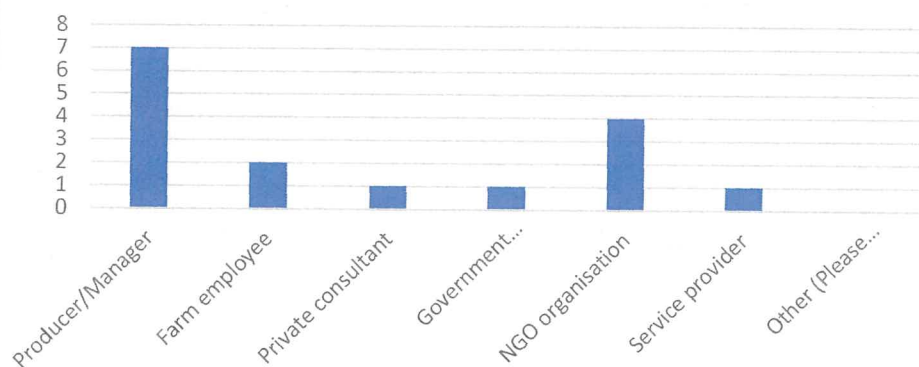
Discussions/comments/observations:

- The Soil Wealth Darwin Farm walk was attended by 16 people from a variety of backgrounds (see graph 1). Attendees were given information packs with details about the project and the project partners, as well as guidelines on soil testing and interpretation, and Nutrient element functions in vegetable crops
- All of the attendees showed enthusiasm and interest in continued involvement with the project throughout its lifetime.
- The discussions generated by the day's program were in depth and whilst it is early days for any clear observations, everyone is looking forward to seeing future results.
- The attendees want to expand the project to other regions in the NT and get more people involved. The value in this kind of demonstration is clearly evident and farmers want to see this get bigger.
- The cover crops had to be replanted two times at the start of the season as the first two plantings died due to lack of rain (v. dry wet season). This resulted in extra tilling activity on the 3 cover crop beds as compared to the control beds.
- The grafted eggplants appear to have come from poor root stock. Some of the eggplants are growing along the ground which creates an additional issue with plants constricting the irrigation tape. Several plants towards the end of the rows have died as a result of lack of water.
- The nets limit access of beneficial species to the eggplants, which is not ideal in an organic system.
- There appears to be less mildew under the nets compared to areas with no nets.
- Ginger Ants have been an ongoing issue.
- It is too early to tell if biochar is influencing yield on the Soil Wealth site. Another area on the farm had biochar applied two years ago and there is a marked difference in the health of the current zucchini crop on that area when compared to the adjacent zucchini crop planted at the same time on a non biochar area. Yield counts have not been undertaken but the farmer has visually observed higher fruit production and better fruit quality in the biochar area.
- Is biochar production in the NT viable? The group thought it was unlikely
- Early indications showed that the yield was higher in the control bed. This could possibly be due to less tilling in that area. Additional tilling on cover crop beds may have reduced soil structure. Could possibly mow cover crop instead of incorporating into the soil.

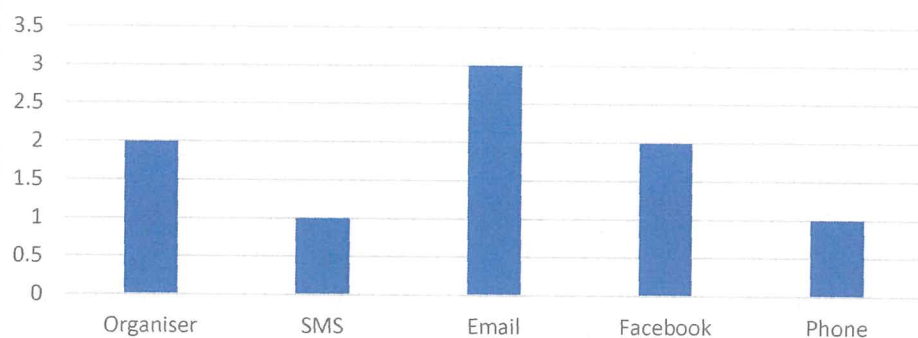
Feedback from evaluation.

The number of people responding has been put in brackets in the graph title. The number of responses vary as some people left questions blank or did not read the question properly and responded incorrectly. Please see graphs/comments below.

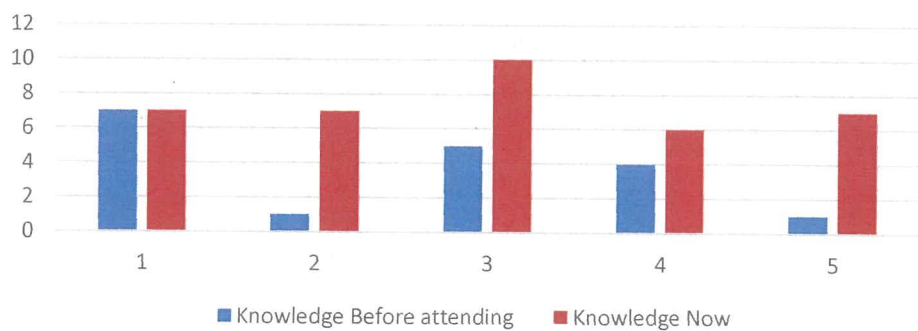
GRAPH 1. Attendee categories (Total: 16)



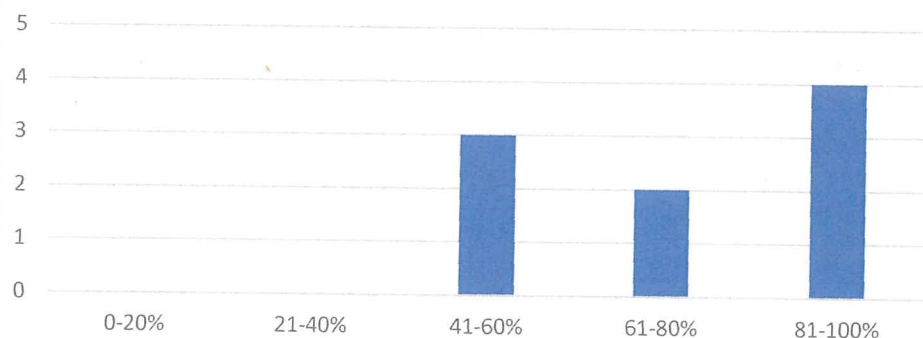
GRAPH 2. How did you hear about this Farmwalk? (9 responses)



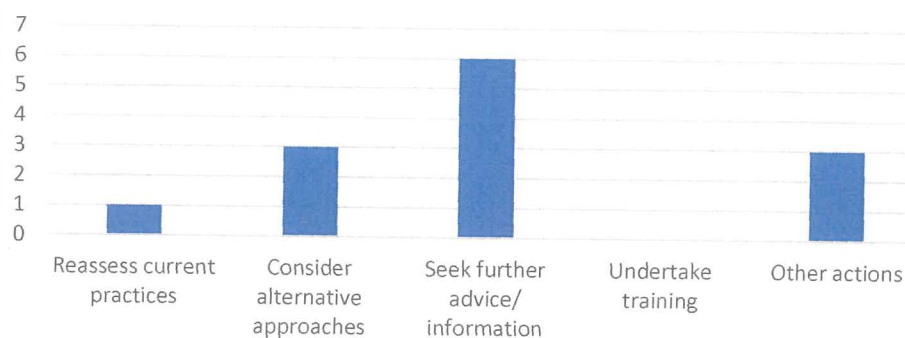
GRAPH 3. Please rate your awareness/understanding / knowledge of Soil Wealth Projects (5 responses)



GRAPH 4. Of the information presented, how much is likely to be useable to you? (9 responses)



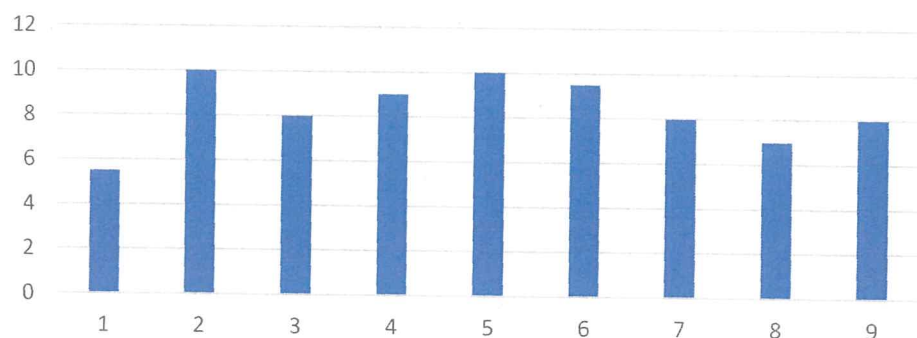
GRAPH 5. As a result of what you heard today, what actions are you likely to take? (9 responses)



Please give details of what you are planning to follow up on:

- Look for funding to experiment
- Get of my backside and make some changes
- Find more info on soil carbon
- Research biochar and the process of growing vegetables (soil wealth

GRAPH 6. Please rate your satisfaction with this farm walk. (1=low, 10=high) Average = 8.3



Attendees (16)

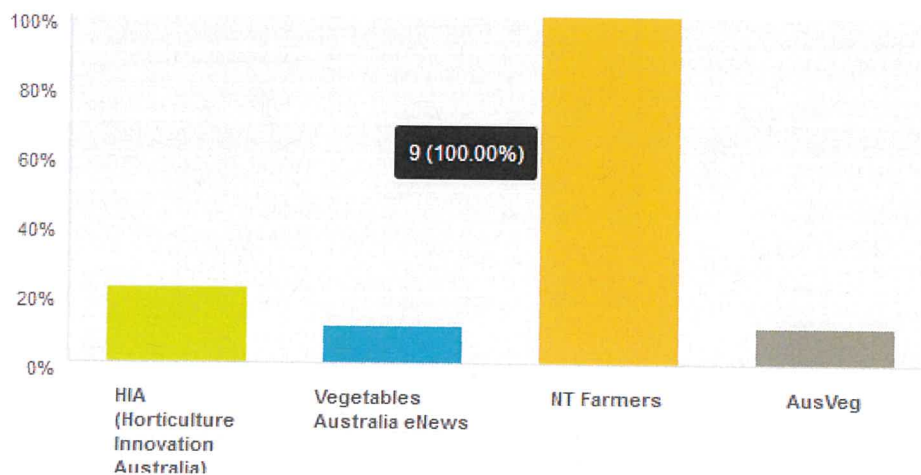
Caroline Biggs	NGO
Debbie Hyder	Producer/Manager
Muy Keav	Farmhand
Till Tilgner	Farmhand

Sam Tocknell	NGO
Bluey Stoldt	Producer/Manager
Ben Hoffmann	Government
Uchchel Ray	Producer/Manager

2. VEGETABLE LEVY SIP MEETING SURVEY RESULTS

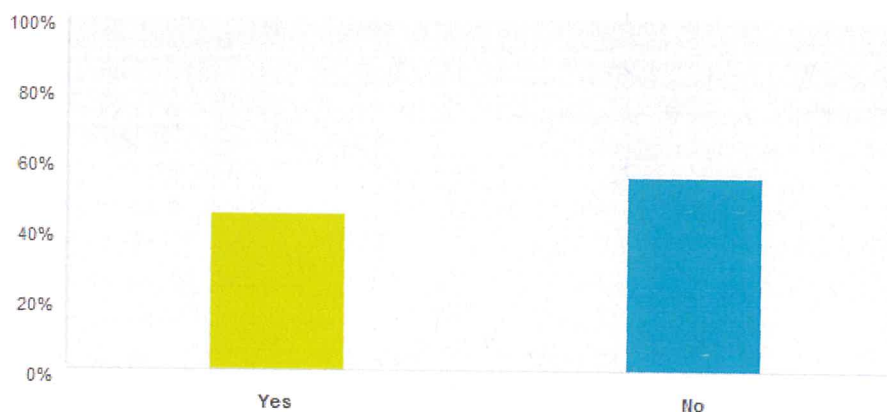
How did you find out about this meeting?

Answered: 9 Skipped: 0



Did you know about the vegetable industry R&D strategic investment plan before this meeting?

Answered: 9 Skipped: 0



Did the meeting successfully explain how the vegetable industry strategic plan dictates investment in R&D in the vegetable industry?

Answered: 8 Skipped: 1



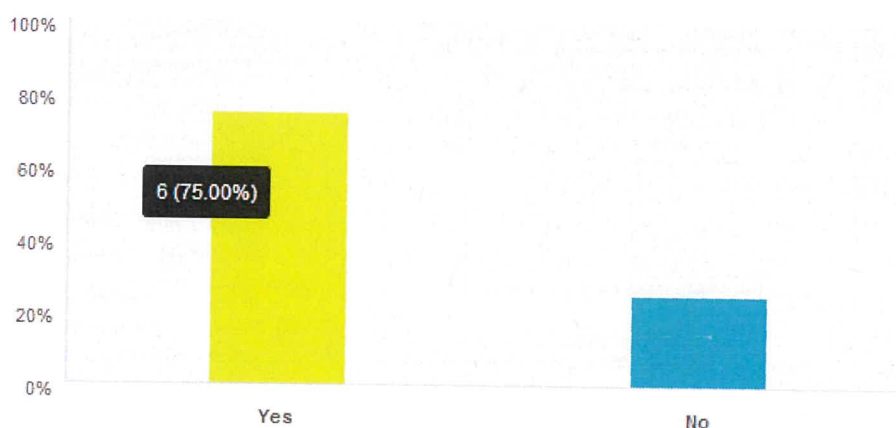
What areas of R&D in the vegetable industry would you like to see emphasised in the next vegetable industry strategic investment plan?

Answered: 9 Skipped: 0



Do you have a better understanding now of how HIA fits into the R&D investment process of the vegetable levy?

Answered: 8 Skipped: 1



How do you think we could get more vegetable growers involved in how their levy money is spent in R&D?

Answered: 6 Skipped: 3

1. Explain to them the importance of this money and where it comes from. I think a lot of the growers in Darwin don't fully understand that this is money that has been taken from their vegetables.
2. Have a separate meeting in Marrakai.
3. The NVEN will go a long way to making growers more aware of the power of the levy as growers discover the past and current R&D and how a dedicated extension effort can engage and assist them.
4. Keep asking the question.
5. Give them something in return that is actually relevant to their commercial reality not what is not of use. NT Gov. seem to have had a long problem with not actually doing research that has relevant outcomes for the NT industry, they are slow to react to issues.
6. By reaching out and continuing to keep the farmers informed and in the loop.

Vegetable and Melon Pre-Season Meeting 2017

On Thursday the 23rd of March NT Farmers held a Vegetable and Melon pre-season meeting at CPRF. This event was run to deliver a meeting for growers before the start of the vegetable and melon season, there was also a need to release important quarantine and biosecurity information and updates relevant to industry before the seasons kick off and to introduce the new IPM demo to growers so that they may know about and interact with the VG15044 project throughout the season and as issues arise. The event attracted 52 attendees across the industry sector, the project leader and project officer were satisfied with the turn out and note that among the attendees there were several leading growers, local agribusiness consultants and key government personnel. In total, 27 growers attended, meaning that 52% of the attendees were growers. An excellent result which demonstrates a very engaged and interested grower group participating in the project as a whole. All attendees provided their contact details so that they may be kept informed of the project developments and events.

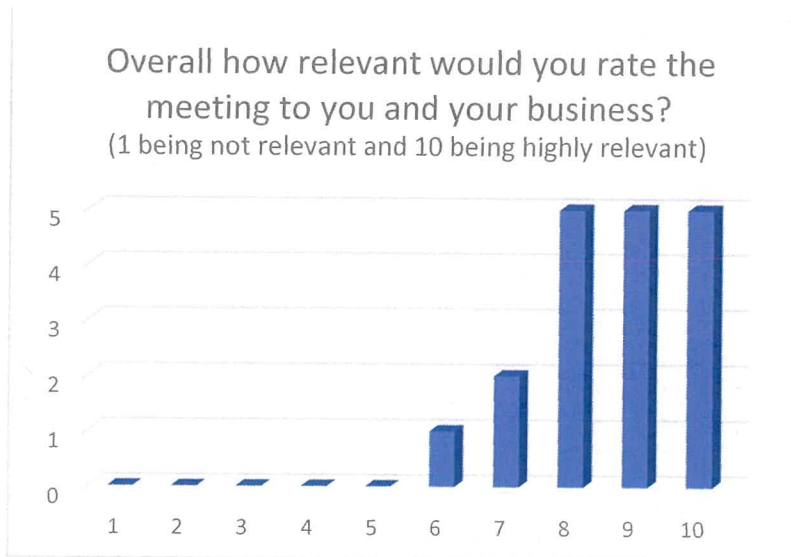
The Vegetable and Melon Pre-Season meeting consisted of a welcome by the NT Farmers President. An update on biosecurity and quarantine matters was provided to growers in which it was mentioned that the NT had 98% compliance with on farm biosecurity since the CGMMV outbreak. DPIF chief entomologist provided an 'Introduction to IPM' presentation, there was also an update on the CGMMV Research Project for Darwin growers including an update on bee research. Finally, to conclude the sit-down portion of the meeting, NT Farmers' Greg Owens introduced the Vegetable Project IPM Demonstration Plot on Coastal Plains Research Farm. The group then split into two. One group explored the field trial plot with Project Leader - Greg Owens, where they examined pre-planting best practice and the process of integrating a green manure crop to build refuge for predators. The other half of the group explored good bugs (predators) and bad bugs (pests) under the microscope with the entomologists and botanist. The groups then swapped over before enjoying a barbeque lunch together. The event was interactive and open, with many growers feeling comfortable to ask questions and actively participate in the field component.

The feedback on the day and following the event was very positive, with many surprised by the turn out and were encouraged by the project NT Farmers is running. To further evaluate the success of the day, attendees were asked to complete feedback forms. 18 people (35%) of attendees completed the feedback form, this is a good response rate and we are pleased that so many could complete a two-page feedback form at the end of a hot day (and considering the large majority of vegetable growers are English Second Language). The results of the feedback survey are below.

NT Vegetable and Melon Pre-Season Meeting Evaluation Report

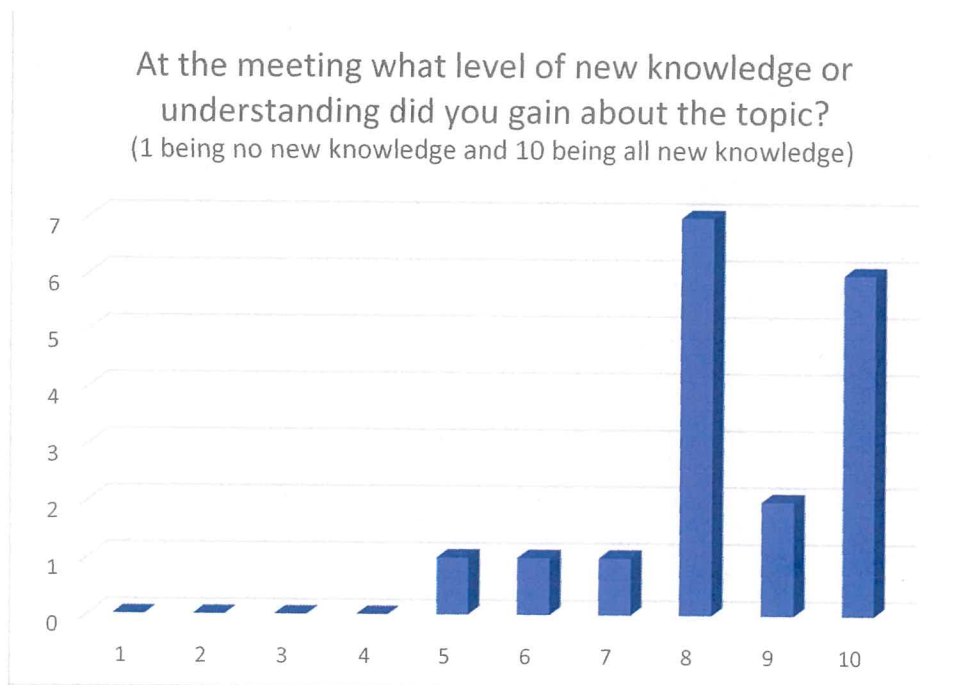


67% of the surveyed attendees were growers or farm owners or managers.



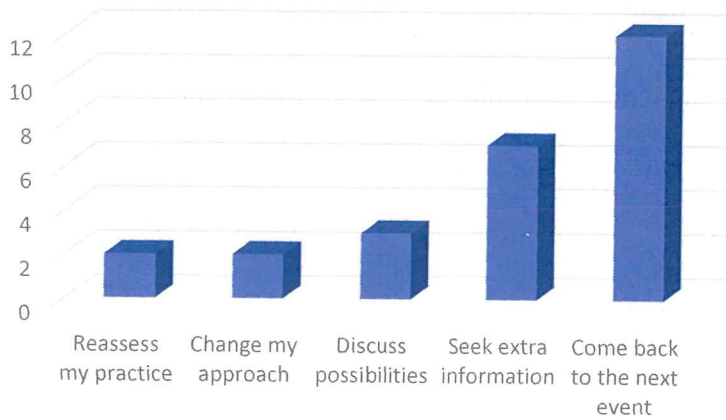
83% of surveyed attendees rated the meeting to them as an 8/10 or relevant.

overall relevancy of higher. Being highly



83% of surveyed attendees gained a significant amount of new knowledge or understanding from the event (being an 8/10 or higher).

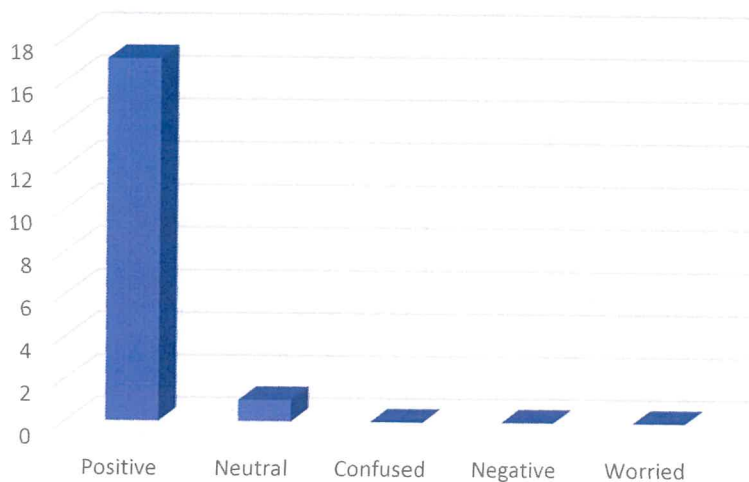
As a result of what you have heard today,
what actions might you take?



67% of surveyed attendees stated that they will come back to the next event.

39% of surveyed attendees stated that they will seek extra information after attending the event. All the surveyed attendees stated that they will take some form of action because of what they heard at the event.

How are you left feeling after this event?



94% of the surveyed attendees were left feeling positive after the event. The remaining 6% were left feeling neutral. None of the survey attendees noted any negative feelings following the event.

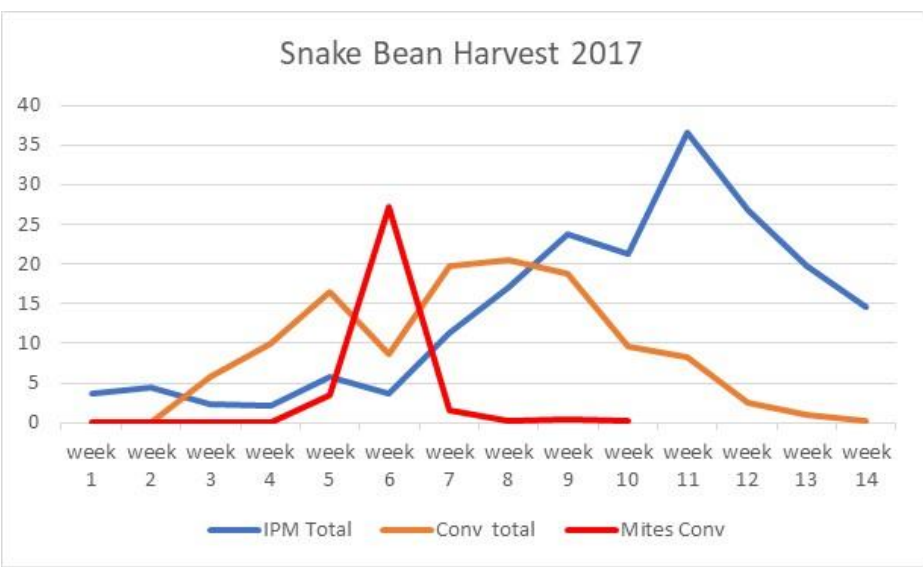
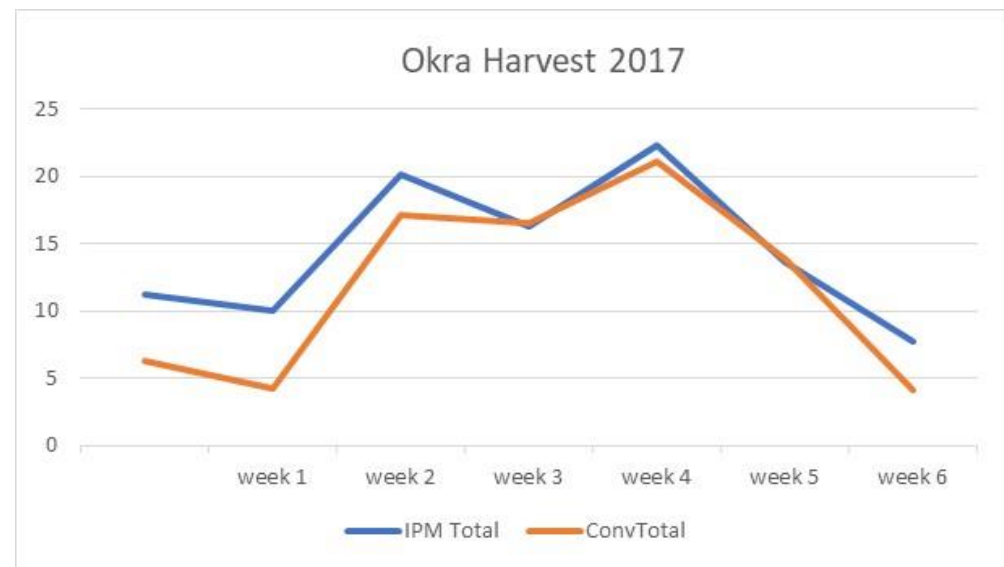
IPM Demonstration Block Production Summary

2017 & 2018

2017 IPM demonstration plot harvest summary

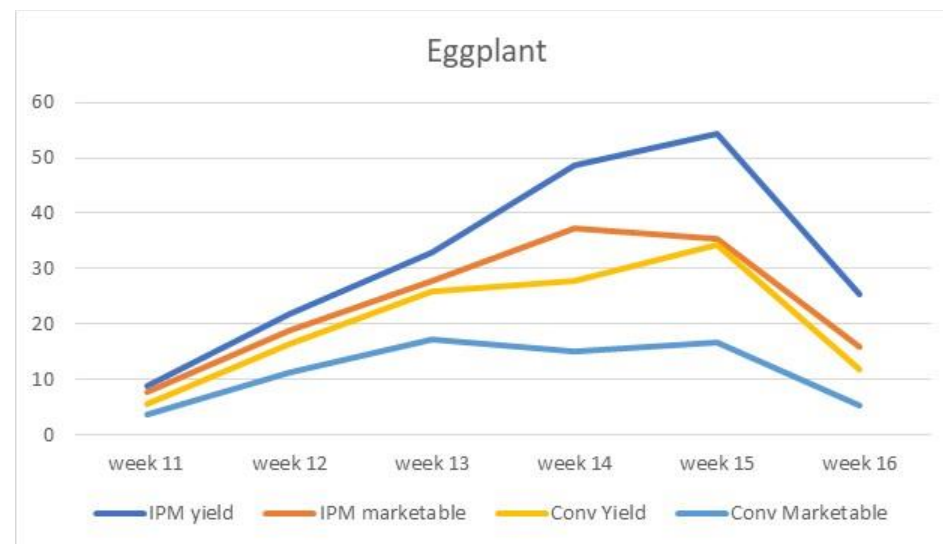
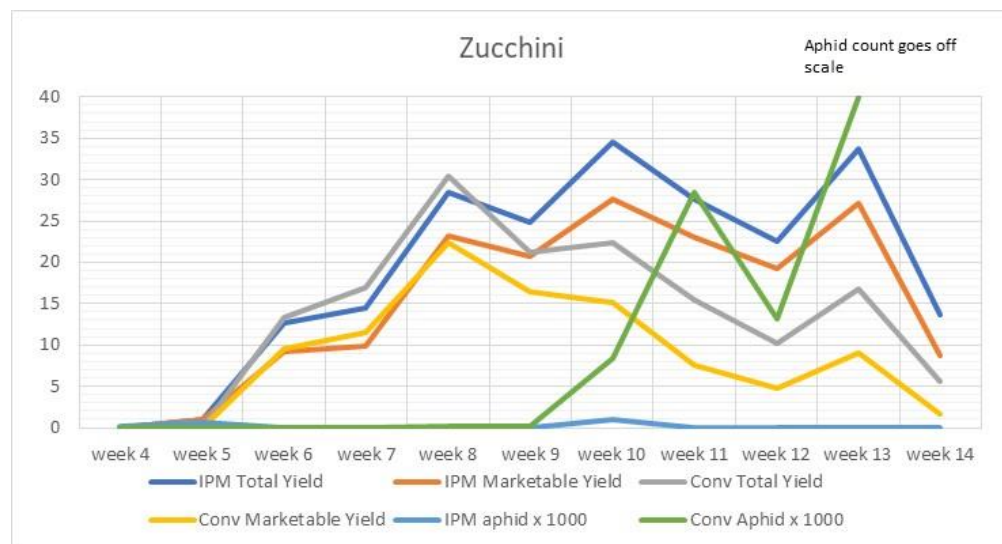
Date		Okra					Date		Beans				
		IPM1	IPM2	Conv1	Conv 2				IPM1	IPM2	Conv1	Conv2	
27-Jun-17	week 1	6.05	5.2	2.7	3.55		27-Jun-17	week 1	3.7				
03-Jul-17	week 2	4.9	5.1	1.8	2.5		03-Jul-17	week 2	4.5				
11-Jul-17	week 3	10	10.1	7.2	10		11-Jul-17	week 3	1.6	0.8	3.9	1.9	
17-Jul-17	week 4	8.75	7.55	7.2	9.33		17-Jul-17	week 4	1.1	1	5.8	4.23	
24-Jul-17	week 5	9.5	12.8	8.8	12.3		24-Jul-17	week 5	3.5	2.3	7.7	8.8	
01-Aug-17	week 6	7.55	6.05	6.2	7.73		01-Aug-17	week 6	2.1	1.6	5	3.73	
06-Aug-17	week 7	3.73	4	2	2.1		06-Aug-17	week 7	5.1	6.3	9.5	10.2	
12-Aug-17	week 8						12-Aug-17	week 8	8.3	8.7	12.3	8.2	
19-Aug-17	week 9						19-Aug-17	week 9	11.9	11.9	10.4	8.3	
26-Aug-17	week 10						26-Aug-17	week 10	8.7	12.5	5.1	4.5	
03-Sep-17	week 11						03-Sep-17	week 11	14.5	22.1	4.2	4	
09-Sep-17	week 12						09-Sep-17	week 12	9	17.8	1.5	1.1	
16-Sep-17	week 13						16-Sep-17	week 13	8.5	11.2	0.9	0.04	
23-Sep-17	week 14						23-Sep-17	week 14	7.6	6.9	0.2	0.1	
Row Yields	25m row	50.48	50.8	35.9	47.51		Row Yields	25m row	90.1	103.1	66.5	55.1	
Total Yields	50m row		101.3		83.4		Total Yields	50m row		193.2		121.6	
% increase			21				% increase			59			
Yield increase per ha			1260	30 x 100m rows/ha			Yield increase per ha			147203.9	25 x 100m rows/ha		
Increased income \$/ha			\$2,898	Assume \$2.30/kg			Increased income \$/ha			\$294,408	Assume \$2/kg		

Production Graphs



2018 IPM demonstration plot harvest summary

IPM Demo Block yield		Total weekly yields						Total weekly yields						Total weekly yields						Total weekly yields											
Date		Zucchini						Okra						Eggplant						Snake bean											
26-Apr-18	Planted	IPM	Market	Loss	Conv	Market	Loss	26-Apr	Planted	IPM	Market	Loss	Conv	Market	Loss	26-Apr	Planted	IPM	Market	Loss	Conv	Market	Loss	26-Apr	planted	IPM	Market	Loss	Conv	Market	Loss
Week ending		Total Yield	Yield	Yield	Yield	Yield	Loss	Week ending		Total Yield	Yield	Yield	Yield	Yield	Loss	Week ending		Total Yield	Yield	Yield	Yield	Yield	Loss	Week ending		Total Yield	Yield	Yield	Yield	Yield	Loss
01-Jun-18	week 5	1	1	0	0	0	0	01-Jun-18	week 5							01-Jun-18	week 5							01-Jun-18	week 5						
08-Jun-18	week 6	12.64	9.15	3.5	13.3	9.6	3.7	08-Jun-18	week 6							08-Jun-18	week 6							08-Jun-18	week 6						
15-Jun-18	week 7	14.4	9.95	4.45	16.9	11.5	5.4	15-Jun-18	week 7							15-Jun-18	week 7							15-Jun-18	week 7						
22-Jun-18	week 8	28.4	23.2	5.2	30.5	22.3	8.2	22-Jun-18	week 8	0.4	0.4	0	1.2	1.2	0	22-Jun-18	week 8							22-Jun-18	week 8						
29-Jun-18	week 9	24.9	20.7	4.2	21.2	16.5	4.7	29-Jun-18	week 9	2.7	1.9	0.8	4.2	1.2	3	29-Jun-18	week 9							29-Jun-18	week 9						
06-Jul-18	week 10	34.6	27.6	7	22.3	15.2	7.1	06-Jul-18	week 10	7.8	5.7	2.1	10.1	5	5.1	06-Jul-18	week 10							06-Jul-18	week 10	5.9	5.1	0.8	9.3	7.8	1.5
13-Jul-18	week 11	27.6	23.1	4.5	15.4	7.6	7.8	13-Jul-18	week 11	10.9	6.4	4.5	12.8	5.6	7.2	13-Jul-18	week 11	8.9	7.8	1.1	5.6	3.6	2	13-Jul-18	week 11	19.2	17.5	1.7	18.9	12.6	6.3
20-Jul-18	week 12	22.6	19.2	3.4	10.2	4.8	5.4	20-Jul-18	week 12	10.8	5.7	5.1	13.9	1.5	12.4	20-Jul-18	week 12	21.9	18.8	3.1	16.3	11.3	5	20-Jul-18	week 12	26.9	22.7	4.2	22.8	11.7	11.1
27-Jul-18	week 13	33.8	27.1	6.7	16.7	9	7.7	27-Jul-18	week 13	22.8	5.9	16.9	23	2.9	20.1	27-Jul-18	week 13	33	27.7	5.5	25.9	17.3	8.6	27-Jul-18	week 13	31.4	26.6	4.8	32.7	20.7	12
03-Aug-18	week 14	13.7	8.7	5	5.6	1.6	4	03-Aug-18	week 14	8.95	2.9	6.05	10.2	1.9	8.3	03-Aug-18	week 14	48.7	37.4	11.3	27.8	15	12.8	03-Aug-18	week 14	23.9	18.5	5.4	33.4	18.6	14.8
10-Aug-18	week 15	Completed						10-Aug-18	week 15	6.4	4.6	1.8	7.4	2.8	4.6	10-Aug-18	week 15	54.3	35.4	18.9	34.25	16.65	17.6	10-Aug-18	week 15	18.45	12.75	5.7	28.7	16.8	11.9
17-Aug-18	week 16							17-Aug-18	week 16	6.6	4.4	2.2	8.5	4.1	4.4	17-Aug-18	week 16	25.4	16	9.4	11.9	5.3	6.6	17-Aug-18	week 16	23.5	16.6	6.9	29.7	17.9	11.8
24-Aug-18	week 17							24-Aug-18	week 17	17.5	8.95	9	13.2	6.65	6.55	24-Aug-18	week 17	Completed						24-Aug-18	week 17	33.85	18.8	15.05	23.75	12.3	10.45
31-Aug-18	week 18							31-Aug-18	week 18	Completed						31-Aug-18	week 18							31-Aug-18	week 18	Completed					
07-Sep-18	week 19							07-Sep-18	week 19							07-Sep-18	week 19							07-Sep-18	week 19						
14-Sep-18	week 20							14-Sep-18	week 20							14-Sep-18	week 20							14-Sep-18	week 20						
Season Total	kg	213.6	169.7	44	152.1	98.1	54	Season Total	kg	94.9	46.85	48.45	104.5	32.85	71.7	Season Total	kg	192.2	143.1	49.3	121.8	69.15	52.6	Season Total	kg	186.5	141.95	44.55	201.7	120.8	79.85
	t/ha	34.2	27.2	7.0	24.3	15.7	8.6		t/ha	15.2	7.5	7.8	16.7	5.3	11.5		t/ha	30.8	22.9	7.9	19.5	11.1	8.4		t/ha	29.8	22.7	7.1	32.3	19.3	12.8
	% yield		79.4	20.6		64.5	35.5		% yield		49.4	51.1		31.4	68.6		% yield		74.5	25.7		56.8	43.2		% yield		76.1	23.9		59.9	39.6
Yield Increase	%	40.46	72.98	67				Yield Increase	%	-9.23	42.62					Yield Increase	%	57.86	106.94					Yield Increase	%	-7.51	17.51				



IPM vs Conventional Farming

Brian Michael Thistleton (1), Greg Owens (2), Haidee Brown (1), Laura Cunningham (2), Michael Neal (1) & Samantha Tocknell (2).
(1) Berrimah Agricultural Laboratory, Northern Territory Department of Primary Industry and Resources, GPO Box 3000, Darwin, NT, 0801, (2) NT Farmers Association, P.O. Box 748, Coolalinga, NT, 0839.

Integrated Pest Management (IPM) is an environmentally sensitive approach to dealing with plant pests which fosters naturally occurring beneficial insects (predators and parasitoids) by reducing pesticide use and, when necessary, using chemicals that are soft on beneficials.

In 2017 plots of okra and snake bean were planted and managed either by IPM (regular monitoring, use of beneficials and spraying only when needed) and conventional techniques (weekly spraying). Pest populations were low in the IPM blocks despite very few sprays being applied and predator and parasitoids were common. The demonstration was repeated in 2018 when zucchini and eggplant were added to the crops planted. Results were extended through field days, posters and presentations.

Outcomes were:

- Growers could see IPM management in action.
- A list of pests and beneficials occurring on okra, snakebeans, zucchini and egg plant in the Top End.
- Effective aphid, mite and caterpillar control in the IPM plot was achieved with no chemical application.
- Most predators and parasitoids built up naturally in the IPM block, in the absence of damaging sprays.
- Significant damage by bean fly in IPM block and an IPM compatible control measure is required.
- The IPM plot had higher yields than the conventional plot.

24 July 2018



Plot 1 - IPM



Plot 2 - Conventional

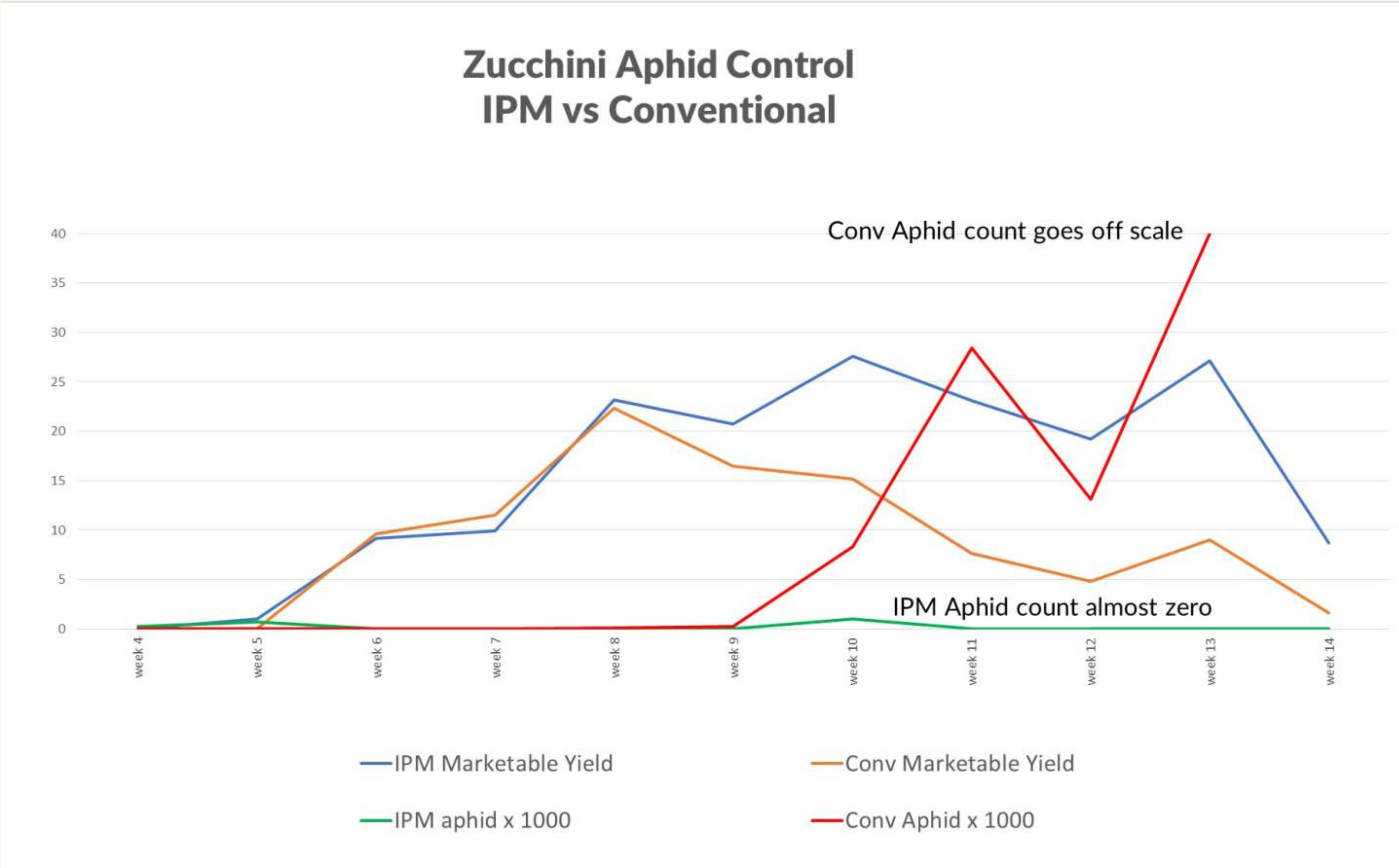
05 September 2018



Plot 1 - IPM



Plot 2 - Conventional



These insects were found on the snake bean, okra, eggplant and zucchini crops at CPRF

Pests



Green vegetable bug nymphs (*Nezara viridula*) on okra.
Size: 1.5-15 mm in length



Pod sucking bug nymph (*Riptortus serripes*) on snake bean
Size: up to 15 mm in length



Melon aphid nymphs and adults (*Aphis gossypii*) on zucchini
Size: 1-2 mm in length



Northern grass pyrgomorph adult (*Atractomorpha similis*) on eggplant
Size: 40 mm in length



Spiny bollworm larva (*Earias vitella*) on okra
Size: Up to 20 mm in length



Bean pod borer larva (*Maruca vitrata*) on snake bean
Size: Up to 25 mm in length



Pumpkin beetle adult (*Aulocophora hilaris*) on zucchini
Size: 6-7 mm in length



Redbanded shield bug adult (*Piezodorus hybneri*) on okra
Size: 8-10 mm in length



28-spotted ladybird adult (*Epilachna vigintioctopunctata*) on zucchini
Size: 5-9 mm in length

Beneficials



Garden spider adult (predator) (*Argiope* sp.) on snake bean
Size: 10-16 mm in length



Spined predatory shield bug eggs (*Oechalia shellenbergii*) on okra
Size: 0.5 mm in length



Tachinid fly adult (parasitoid) (Family Tachinidae) on okra
Size: Up to 20 mm in length



Lacewing eggs (predator) (Family Chrysopidae) on eggplant
Size: 0.5 mm in diameter



Zig zag ladybird adult (predator) (*Menochilus sexmaculatus*) on snake bean
Size: 3-6.5 mm in length



Praying mantis adult (predator) (*Orthodera* sp.) on snake bean
Size: 40 mm in length



Assassin bug adult (predator) (*Scipinia arenacea*) on snake bean
Size: 20 mm in length



Hover fly larva (predator) (family Syrphidae) on okra
Size: 1-10 mm in length



Hover fly adult (pollinator) (*Eumerus* sp.) on zucchini
Size: Up to 10 mm in length

IPM vs Conventional Farming

Brian Michael Thistleton (1), Greg Owens (2), Haidee Brown (1), Laura Cunningham (2), Michael Neal (1) & Samantha Tocknell (2).

(1) Berrimah Agricultural Laboratory, Northern Territory Department of Primary Industry and Resources, GPO Box 3000, Darwin, NT, 0801, (2) NT Farmers Association, P.O. Box 748, Coolalinga, NT, 0839.

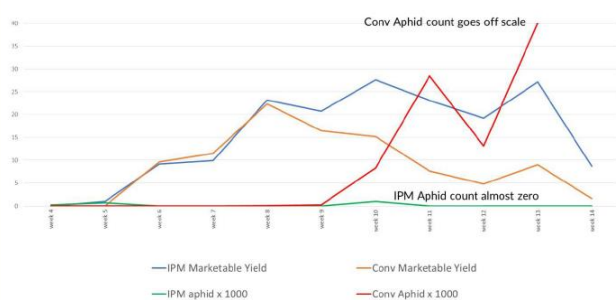
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- The IPM plot had higher yields than the conventional plot.

**Zucchini Aphid Control
IPM vs Conventional**



24 July 2018



Plot 1 - IPM



Plot 2 - Conventional

05 September 2018



Plot 1 - IPM



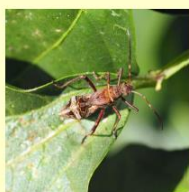
Plot 2 - Conventional

These insects were found on the snake bean, okra, eggplant and zucchini crops at CPRF

Pests



Green vegetable bug nymphs
(*Nerzara viridula*) on okra.
Size: 1.5-15 mm in length



Pod sucking bug nymph
(*Riptortus solanipes*) on snake bean
Size: up to 15 mm in length



Meion aphid nymphs and adults
(*Aphis gossypii*) on zucchini
Size: 1-2 mm in length



Northern grass pygmy moth adult
(*Atractodes similis*) on eggplant
Size: 40 mm in length



Spiny bollworm larva
(*Pectinophora gossypiella*) on okra
Size: Up to 20 mm in length



Bean pod borer larva
(*Maruca vitrata*) on snake bean
Size: Up to 25 mm in length



Pumpkin beetle adult
(*Autocorypha nitens*) on zucchini
Size: 6-7 mm in length



Redbanded shield bug adult
(*Pezodorus hybneri*) on okra
Size: 8-10 mm in length



28-spotted ladybird adult
(*Epicauta vigintioctopunctata*) on zucchini
Size: 5-9 mm in length

Beneficials



Garden spider adult (predator)
(*Argiope* sp.) on snake bean
Size: 10-16 mm in length



Spined predatory shield bug eggs
(*Oecalia shoenbergeri*) on okra
Size: 0.5 mm in length



Tachinid fly adult (parasitoid)
(Family Tachinidae) on okra
Size: Up to 20 mm in length



Lacewing eggs (predator)
(Family Chrysopidae) on eggplant
Size: 0.5 mm in diameter



Zig zag ladybird adult (predator)
(*Mitsukurina owstoni*) on snake bean
Size: 3-6.5 mm in length



Praying mantis adult (predator)
(*Ortodera* sp.) on snake bean
Size: 40 mm in length



Assassin bug adult (predator)
(*Scipionia arenacea*) on snake bean
Size: 20 mm in length



Hover fly larva (predator)
(family Syrphidae) on okra
Size: 1-10 mm in length



Hover fly adult (pollinator)
(*Eumerus* sp.) on zucchini
Size: Up to 10 mm in length

Project data from Hort Innovation
VG15044 and Landcare SGRI-0836

For further information contact
Entomology on 8999 2258 or go to
www.cprf.nt.gov.au



VG15044 Convention Evaluation Sheet

Activity: 2017 National Horticulture Convention Adelaide
including Pre-convention Product Innovation Seminar and Post-convention Export workshop

Activity Date: May 2017

Evaluation Method: Oral Interview

Participant: Minh Do

Farm Details: Lebanese Cucumbers
Darwin River NT

Questions:

- 1. What was the best part of attending the National Horticulture Convention in Adelaide this year?**
I went to the Innovation workshop that had lots of new ideas, and the trade show had many things I can use on my farm. There was not many other Vietnamese farmers there
- 2. What did you get out of attending the National Horticulture Convention for your business?**
Not much for my farm and I had to leave early as my family had some family problems.
- 3. What did you get out of attending the National Horticulture Convention personally?**
I got good information at the Trade Show. The presentations were hard to follow so I spent a lot of time looking at products and equipment. There are some new chemical I will try.
- 4. What part did the Vegetable Engagement project VG1504 have in you attending the convention?**
Greg helped organise all my travel and money for some accommodation for the convention. I would have not made it without this help.
- 5. How well was the activity organised and managed?**
Greg made sure it all went good. My family caused problems, so I had to rush back to the farm in Darwin
- 6. What could be done better?**
I wanted to stay for the whole time. I missed the dinner
- 7. How can we get more growers to attend the next convention?**
It's very hard to leave my farm in the busy time and the time is too long.
- 8. Would you attend the next convention on the Brisbane in 2018?**
If it is shorter.

VG15044 Convention Evaluation Sheet

Activity: 2018 Hort Connections Brisbane

Pre-convention Product Innovation Seminar and Export workshop

Activity Date: June 2018

Evaluation Method: Oral Interview

Participant: Michael Quach

Farm Details: Lebanese and continental hydroponics cucumbers
Lake Bennett NT
Board Member AUSVEG NT Rep

Questions:

- 1. What was the best part of attending the 2018 Hort Connections in Brisbane this year?**
It was good to meeting farmers who also supply supermarkets and the trade show was very big with lots of products and machinery to look at.
- 2. What did you get out of attending the 2018 Hort Connections for your business?**
The trade show was very big and I saw a lot of things I can use for my farm but need more time to get around it all.
- 3. What did you get out of attending the 2018 Hort Connections personally?**
I met some of the market agents in knew in Melbourne and the AUSVEG board meeting i
- 4. What part did the Vegetable Engagement projectVG1504 have in you attending the convention?**
NT Farmers helped me to get onto the AUSVEG board after winning the Community Stewardship award in 2016. The Veg project helped me when my phone connections don't work well at Lake Bennett.
- 5. How well was the activity organised and managed?**
AUSVEG organises my travel but it was good to organise with Greg so we could share taxis and stay at the same hotel.
- 6. What could be done better?**
They can shift the Convention, so it is not in my busy season. I should be on the farm not in Brisbane.
- 7. How can we get more growers to attend the next convention?**
Have the convention at another time of the year so NT growers can come. Maybe shift it to Darwin for a year but I don't think we could take all these people in Darwin.
- 8. Would you attend the next convention in Melbourne in 2019?**
Yes, I am still on the AUSVEG board so I guess I will be there anyway. I would like to see more Vietnamese growers going to it.

VG15044 Convention Evaluation Sheet

Activity: 2019 Hort Connections Melbourne

including Innovation Seminar and Export workshop

Activity Date: June 2019

Evaluation Method: Phone Oral Interview

Participant: Chris Pham

Farm Details: Bitter melon, okra, Lebanese cucumber
Marrakai

Questions:

1. What was the best part of attending the 2019 Hort Connections Melbourne this year?

Meeting people from the same industry who can understand the issues we are facing, especially as we are in such an isolated situation at Marrakai. It was good to talk to other growers who also supply supermarkets and have to meet all the QA requirements that we have too.

9. What did you get out of attending the 2019 Hort Connections Melbourne for your business?

The trade show was very busy and I didn't get to talk to many people but I got some good packages of information especially about tomatoes which are our major crop.

10. What did you get out of attending the 2019 Hort Connections Melbourne personally?

We made really good contacts with other growers around Australia and learnt a lot about how the vegetable industry works in other places.

11. What part did the Vegetable Engagement project VG1504 have in you attending the convention?

Now I work at part time NT Farmers I had the opportunity to attend and the project helped organise funding for me to attend.

12. How well was the activity organised and managed?

It was extremely well organised, and we had a good group in Melbourne

13. What could be done better?

Not sure what would make it better, it was all very good.

14. How can we get more growers to attend the next convention?

Try and make it for a shorter time. 5 days is too much when other growers are in a busy time in our season. It was just lucky we had not started a full harvest yet and I could get away.

15. Would you attend the next convention in 2020?

Yes, definitely. I would be better at bringing back information from the convention and trade show.

VG15044

Regional capacity building to grow vegetable business – Northern Territory

Document Purpose

The purpose of this document is to provide a Monitoring and Evaluation Framework for this project. This will guide the data collected for review and reporting purposes of the project.

Project Purpose

To identify gaps in best practice management and address issues through extension and capacity building projects.

Building on the success of the previous engagement projects by further facilitating the adoption of best practice in the areas of production, supply chain, and business practices.

The aim is to bring the scientific based results of current research and industry best practice from other regions in the vegetable field to the Northern Territory Growers.

This project contributes to the following Objectives:

- To deliver regional capacity building services to the vegetable industry
- To increase knowledge of vegetable R&D and facilitate the adoption of R&D by vegetable businesses.
- To increase the reach of the vegetable R&D program by engaging stakeholders in the vegetable value chain and developing trusted networks at a regional level.
- To provide linkages to the national industry communications services (delivered by AUSVEG through VG15027, 'Vegetable industry communications').
- To provide linkages to the National vegetable training initiative VG15028.

Vegetable Industry– Strategic Investment Plan 2012-2017

This project contributes to the achievement of the Vegetable Industry Strategic Investment Plan 2012 – 2017 Objective:

- increasing industry knowledge of R&D investments and providing a supporting environment to regional capacity building projects which aim to increase knowledge, engagement and adoption of the vegetable R&D program

Project Approach

The key activities/outputs of this project are:

1. Development of annual work plans
2. Design of extension activities targeting information needs of the target audience
3. Identifying gaps in adoption of knowledge and practices resulting from the vegetable R&D program
4. Delivery of extension events
5. Communication and engagement with growers and industry stakeholders
6. Project evaluation and reporting.

Context

Vegetable production in the Northern Territory has increased significantly in the last 15 years, predominantly due to the Vietnamese and Cambodian growers. The Northern Territory relies on its market window with most vegetable production occurring in the Dry season which is the southern winter period and supplies the Traditional wholesale and Asian markets in Sydney, Melbourne and Adelaide.

There are now about 140 vegetable growers in the Darwin area (CGMMV survey 2014-16) as well as about 10 more traditional pumpkin growers in the Katherine Douglas Daly and Mataranka areas. Key vegetables grown are Asian melons, traditional cucurbits like cucumber, squash, zucchini and pumpkin, snake beans and okra with a smaller amount of Asian greens, capsicums, chilies, eggplant, spring onions, tomatoes and herbs. The industry was estimated to be worth between \$30-40million in 2015 even with the incursion of Cucumber Green Mottle Mosaic virus (CGMMV).

The Northern Territory is a developing region for vegetable production in Australia. There was, and still is, a need to demonstrate to growers the current best practice crop and business management and to provide ongoing support in adopting research and development. Growing practices such as spray programs, biosecurity, food safety, pest and disease management and product integrity could all have implications for the broader vegetable industry in terms of market access and quality assurance. There is also a move to more intensive production in hydroponics and protected cropping as soil diseases and pest and other disease pressures mount which need significant support and improved access to the latest research and development in the area.

Engagement plan

The NT vegetable growers are a very diverse group and include many South East Asian nationalities. The Vietnamese growers have a very active group in the NT Vietnamese Horticulture Association which is a major point of access to these growers. The Vice-President of this NT Vietnamese Horticulture Association is now a director on the NT Farmers board and has indicated his interest in being a big part of the project. There is a very high proportion of vegetable growers in the NT who are Asian growers and the Vietnamese growers almost all use this association as their major social and technical support.

The Cambodian growers are less organised with a series of informal and personal linkages. NT Farmers project staff will use the relationships developed out of the CGMMV and banana freckle incursions in 2014 and 2015 and the changes to the Darwin Rural regional water licensing regulations in 2016 to increase and formalise an NT Cambodian growers' group. Group text and email communications are becoming more effective as both Asian groups are making increased use of electronic media as market agents in Sydney and Melbourne finally abandoning fax machines. There are a number of second-generation growers starting to appear who have excellent English communication and IT skills.

The support industries also provide an excellent avenue to contact growers and assess issues and impacts on the NT vegetable industry. These stakeholders have an economic interest in improving grower profitability and sustainability which translates into best practices and improved communication and logistics for the NT vegetable producers. The project leader has extensive contacts in this area and in the past has partnered with many representatives in these support industries to deliver extension services, run demonstrations, on-farm trials and supply chain monitoring and improvement.

There is the opportunity to include a number of industry champions on the reference group for this project. Industry champions are excellent allies in the engagement process. The reference group includes leading Asian vegetable growers, experienced Territory supply chain operators, Primary Industries staff currently working in vegetable area and key Association staff. Each comes with their own circle of growers and will provide access to different sections of the vegetable growing community. The commitment and energy these stakeholders bring to the project will be a major driver in the engagement process. As an ex-extension officer of the NT DPI&F and Science and Agriculture teacher at the local high School in the Darwin Rural community the project leader has an extensive local and interstate industry, education and training network.

The initial engagement of the growers in VG12113 and the success of the work done in managing the biosecurity incursions in the NT are the keys to the ongoing success of this project. The project needs to continue to deliver value to the growers. The project officers need to offer something of value, either information or service, during the visits so that there is a development of the perception of benefit to the growers which will lead to good-will and welcome. This banking of social capital is a critical concept in working with Asian growers that have often experienced more withdrawals than deposits from government agencies. As the project develops and best practice issues of production, supply chain and farm management emerge then the engagement will become more individualised, meaningful and mutually beneficial as the project officer responds to the identified needs of the growers.

Project Log Frame and Monitoring and Evaluation Framework

Project Name: Regional capacity building to grow vegetable business – Northern Territory

Number: VG15044

Commencement date: 01/08/2016

Completion date: 01/08/2019

Evaluation Level	Project Details	Performance Measures	Evaluation Methods
Broader Goals Potential impacts on industry productivity, profitability, environmental and/or social benefits End of Program Goals [which the project is contributing towards] <ul style="list-style-type: none"> Horticulture Innovation Australian 	Potential Long Term Impact <ul style="list-style-type: none"> Increased size, efficiency, sustainability and profitability in the vegetable industry Australian community recognises and is supportive of the contribution of the vegetable industry. Horticulture Innovation Objectives <ul style="list-style-type: none"> Vegetable Industry Strategic Investment Plan 2012 – 2017 objective: increasing industry knowledge of R&D investments and providing a supporting environment to regional capacity building projects which aim to increase knowledge, engagement and adoption of the vegetable R&D program. [To be updated post 2017] 	<ul style="list-style-type: none"> Extent to which the vegetable industry is growing, has increased efficiency and profitability. Extent to which community are aware and supportive of the vegetable industry. <ul style="list-style-type: none"> Extent to which vegetable growers are aware and supportive of R&D investments and the trend over time. Extent to which vegetable growers are engaged in capacity building activities and who access information and outputs. 	[Not the responsibility of the funded project] <ul style="list-style-type: none"> National and regional economic and production statistics for vegetable production. Community surveys and media analysis. <ul style="list-style-type: none"> National and regional industry surveys. Cumulative data from regional capacity building projects. Feedback from industry representatives.
Immediate Outcomes [expected to be achieved in the life of the project] <ul style="list-style-type: none"> Extent of Awareness Gains in Knowledge and Skills Extent of practice change 	Industry strengthening <ul style="list-style-type: none"> Strengthened networks and appreciation for significance of region's vegetable industry Knowledge and Capacity gains	<ul style="list-style-type: none"> Extent to which networks have been strengthened – in terms of stakeholder groups, roles and numbers. <ul style="list-style-type: none"> Extent to which vegetable growers in region are aware of current and recent 	<ul style="list-style-type: none"> Matrix showing extent of effective network in region – at commencement and completion of the project. <ul style="list-style-type: none"> Annual grower telephone survey with questions relating to

Evaluation Level	Project Details	Performance Measures	Evaluation Methods
<ul style="list-style-type: none"> Indicative benefits Barriers and Enablers 	<ul style="list-style-type: none"> Increased reach and knowledge of vegetable R&D, innovation and technology: 80% of all vegetable growers in region to be aware of the program and events and main messages being promoted in region. 30% of industry (approx. 3000 hectares) better able to identify issues and opportunities and access information or resources to make appropriate changes. <p>Practice change</p> <ul style="list-style-type: none"> Increased adoption of improved practices and innovation: 40% of growers (60% of industry (approx. 3000 hectares) across all industries adopt one or more of the targeted management improvements/innovations. <p>Indicative Impact</p> <ul style="list-style-type: none"> The 50% of growers who make one or more of the targeted changes will have improved their profitability by a minimum of 5%. 	<p>relevant vegetable R&D, innovation and technology and main messages – compared to target.</p> <ul style="list-style-type: none"> Number of growers and % by size of growers who have participated in capacity building activities and indicate a gain in their knowledge and ability to ID and address issues and opportunities. Number of growers by size and type of production who have adopted one or more improved practices compared to target. Evidence that growers who have made one or more changes have (potentially) increased profitability and the extent of that gain compared to target. 	<p>awareness, changes made and influence of project activities.</p> <ul style="list-style-type: none"> Project records on activities and participation and feedback sheets from participants. Narratives capturing incidences of changes and indicative impacts. Case studies of farms having made changes with economic analysis.
<p>Influencing Activities [expected to be undertaken during the project]</p> <ul style="list-style-type: none"> Communication activities Extension Activities – field days, farm walks 	<p>Communication</p> <ul style="list-style-type: none"> Weekly e-News Bulletin Bi-Monthly articles in Newsletter Bi-monthly article in AUSVEG Magazine Facebook page Twitter page SMS alerts for issues arising and events Face to face meetings Member briefings <p>Industry engagement</p> <ul style="list-style-type: none"> 12-monthly update meetings with consultants and service organisation representatives <p>Extension</p>	<ul style="list-style-type: none"> Extent of distribution of newsletter and articles, awareness and value perceived by growers and their consultants. Facebook followers, interaction and value perceived by grower followers. Type, number and reaction to SMS alerts by growers and their consultants. Number, type and topics of meetings, participation by consultants, value perceived and use made of information. 	<ul style="list-style-type: none"> Project and internet statistics on distribution and access of newsletter. Facebook page analysis and statistics. Project records on use of SMS alerts. Questions in annual grower survey on value and use of information provided.

Evaluation Level	Project Details	Performance Measures	Evaluation Methods
	<ol style="list-style-type: none"> 1. Delivery of 4 Annual Grower Activities a yr: including workshops, field days, seminars, farm walks and other capacity building activities, across three main vegetable crops. 2. Assistance and participation in vegetable industry events <ul style="list-style-type: none"> o Attendance to National Horticulture Convention o Attendance at Trade Show 3. Hold 1 multi-vegetable field day 4. Targeted one-on-one visits with vegetable producers to assist with R&D take-up 5. Facilitate a network of leading growers in each sub-region. Develop a flexible program of informal meetings and farm visits. To foster innovation at farm level. 6. Participate in relevant industry and regional networking meetings 	<ul style="list-style-type: none"> • Number, type and topics of workshops and field day, participation by growers – type, size – value perceived and use made of the information. • Type of assistance and participation in vegetable industry events and networking meetings, extent of added value, reaction by participants and use made of information. • Type of multi-vegetable field day held and its main purpose • Number and topics of one-on-one visits and extent to which these assisted uptake of R&D and facilitated change. • Details of number, frequency, participants (including type and size), topics, process and perceived value of innovation learning groups and actions and decisions resulting. • Details of the number and type of industry and regional network meetings 	<ul style="list-style-type: none"> • Project records on details and participants at events and meetings. • Feedback sheets from participants in consultant update meetings. • Feedback sheets from participants in workshops and field day. • Interview and narratives of grower participation and learnings in National Horticulture Convention and Trade Show events, seminars and workshops • Feedback sheets from participants of the field day • Interview and narratives of grower learnings and application of R&D from face to face visits • Annual structured feedback review with members of vegetable innovation learning group. • Extension officer report on participation in industry and networking meetings.
Outputs [expected to be developed from the project] <ul style="list-style-type: none"> • New information products or packages • New understanding or knowledge 	Extension materials <ul style="list-style-type: none"> • Grower friendly R&D information and project results <ul style="list-style-type: none"> o 5 technical notes o 3 simplified R&D reports on specific vegetables • Strategic Events calendar – in conjunction with other industry providers. 	<ul style="list-style-type: none"> • Number and topics of extension materials, their accuracy, details of circulation/ requests, perceived user-friendliness and usefulness to growers and consultants. 	<ul style="list-style-type: none"> • Project records on outputs, feedback from Hort Innovation; peer review of outputs. • Questions in annual grower survey in relation to extension materials.

Evaluation Level	Project Details	Performance Measures	Evaluation Methods
	Project reports <ul style="list-style-type: none"> • Annual Operating Plans • MER Plan • Updates to Hort Innovation • 6 monthly milestone status reports • Mid-term project review report • Final report 	<ul style="list-style-type: none"> • Extent to which calendar completed and is comprehensive, useful and used to growers and other stakeholders. • Extent to which planned reports are completed in relation to needs and timing and are at required detail and quality. 	<ul style="list-style-type: none"> • Project details of calendar. Feedback from growers and consultants in usefulness and value. • Acceptance and feedback from Hort Innovation.
Foundational Activities [planned to be used to undertake and advise the project] <ul style="list-style-type: none"> • Advisory Committees • Project team – including producer members • Formation of a Project Reference Group from NT DPIR, TNRM and Local Leading Growers • Funds and in-kind 	Development <ul style="list-style-type: none"> • Provide feedback to Hort Innovation on R&D gaps and needs. • Subcontract the development of grower-friendly materials and reports from R&D outputs. Governance <ul style="list-style-type: none"> • Link with Coordinating project • Staffing: industry Services officer; Extension Officer; industry development officer • Organisation support staff • Informal Advisory Group 	<ul style="list-style-type: none"> • Extent and usefulness of feedback to Hort Innovation and extent of action taken. • Number and type of materials and report re-writing subcontracted and quality of subcontractors and their approach. • Type and extent of linking with the coordinating project. • Engagement, role and time input from staff. • Type and adequacy of organisational support provided. • Makeup of Advisory Group, number of meetings, satisfaction of members with role, extent of input and their influence on the project. 	<ul style="list-style-type: none"> • Feedback from Hort Innovation on R&D gaps; • Project records of sub-contracting and completion. • Project records on linkages, staffing. • Interview feedback from linkage project leader. • Feedback sheets by Advisory Group members. • Interviews with project staff • Interviews with Hort Innovation staff.

VG15044 M&E Action Plan

M&E Method [from Evaluation Methods column]	Purpose/Focus	Details	Responsibility and Timing
Network matrix	To show numbers, type and linkages between key stakeholders of regional vegetable industry.	This lists key stakeholders in a table and the strength of linkages and the change over time. This could be done using social network analysis software	Project leader to undertake/manage - beginning and end of project.
Annual Grower vegetable grower survey	To capture extent of awareness, satisfaction, knowledge gains, changes made, influence of project activities, barriers and gaps.	This is a randomised short phone and online surveys of 30 - 50 vegetable growers, asking questions needed for reporting and planning.	Project leader to initiate with support of project evaluation in design. Staff member to undertake or use sub-contractor. Annually in December.
Narratives	To capture observed/known change in practice resulting from project activities in a structured way.	Narratives are short, structured observations detailing how growers/others participated in activities and then took action. They follow a set framework.	Project staff to capture these as they observe or learn about them over time and put them on the on-line M&E platform.
Case studies	To provide a more in-depth analysis of changes made and their costs and benefits.	Case studies follow a similar framework to narratives but require a farm visit and gaining quantitative details for analysis.	Project leader to ensure that these are undertaken in the second and third year for the project – by staff members or subcontractor.
Evaluation feedback for – meetings, workshops, field days, farm walks, demonstrations, training workshops, consultant and committee meetings	To capture reactions, perceived value, gains in understanding, intentions to act and issues needing addressing.	Feedback methods will be adapted for each activity and user group, including individual ethnic groups that make up the vegetable grower population.	Event/meeting organiser to be responsible for modifying feedback method for the purpose, and having these completed and entered on the on-line M&E platform.
Interviews with staff, Advisory Group members, Hort Innovation staff, coordinating project leader	To gain feedback on what is working well, what needs attention, how well input is being given and acted on.	These will follow similar lines of questioning using a semi-structured format and summarised against main headings.	Project leader to organise – preferably using a non-team member to undertake the interviews.



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VG15044 Regional capacity building to grow vegetable business. NT

Activity title

Participant Feedback Sheet

Thanks for providing this feedback. It is important that we are able to understand how useful the event was and how we can improve future events.

Date:

Location:

Topic:

1. Which group best describes your role:

- ☐ Producer/Manager
- ☐ Farm employee
- ☐ Consultant
- ☐ Government employee
- ☐ Service provider
- ☐ Other (Please describe)

2. If a producer, please note the type of crop you grow and the approximate number of hectares you use to grow these crops?

Type: ha

Type: ha

Type: ha

Type: ha

3. Overall, how relevant would you rate the meeting to you and your enterprise?

Not at all relevant ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Highly relevant

Comments:

4. What could have made the meeting more beneficial to you?

Comments:

5. At the meeting what level of new knowledge or understanding did you gain about:
Topic 1:

No new knowledge ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 A significant amount

Topic 2:

No new knowledge ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 A significant amount

6. What is a key message that you are taking away from the (event)?

7. As a result of what you have heard at the (event / forum, etc), what actions (if any) have you been prompted to take following the (workshop/meeting/forum/field day) – please tick any that are appropriate:

- ☐ Reassessing practice
- ☐ Changing your approach/advice to
- ☐ Discuss possibilities with my consultant/clients
- ☐ Seek extra information or training
- ☐ Come back to the next field day
- ☐ Other actions:

7.7 Please give details of what you are planning to follow up and/or take actions on:

8. Please indicate what other information or assistance you might need to act on the information you have gained:

9. Please make any other comments or suggestions about the event or [] it's management:

Thank you for your feedback

Example



VG15013 Improved Management Options for Cucumber Green Mottle Mosaic Virus

Participant Feedback Sheet

Thanks for providing this feedback. It is important that we are able to understand how useful the event was and how we can improve future events.

Date: 15/12/2016

Location: Katherine research Station

Topic: CGMMV R&D grower feedback meeting

1. Which group best describes your role:

- ☐ Producer/Manager
- ☐ Farm employee
- ☐ Consultant
- ☐ Government employee
- ☐ Service provider
- ☐ Other (Please describe)

2. If a producer, please note the type of crop you grow and the approximate number of hectares you use to grow these crops?

Type: ha

Type: ha

Type: ha

3. Overall, how relevant would you rate the meeting to you and your enterprise?

Not at all relevant ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Highly relevant

Comments:

4. What could have made the meeting more beneficial to you?

Comments:

5. At the meeting what level of new knowledge or understanding did you gain about:
Biosecurity situation for CGMMV

No new knowledge ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 A significant amount

Results of Current R&D in CGMMV

No new knowledge ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 A significant amount

6. What is a key message that you are taking away from the (event)?

7. As a result of what you have heard at the meeting what actions (if any) have you been prompted to take following the meeting) – please tick any that are appropriate:

- ☐ Reassessing biosecurity practice
- ☐ Changing your approach to managing weeds
- ☐ Discuss possibilities with my consultant/clients
- ☐ Seek extra information or training
- ☐ Come back to the meeting
- ☐ Other actions:

8. Please give details of what you are planning to follow up and/or take actions on:

9. Please indicate what other information or assistance you might need to act on the information you have gained:

10. Please make any other comments or suggestions about the event or it's management:

Thank you for your feedback



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VG15044 Regional capacity building to grow vegetable business. NT

Annual survey of NT Vegetable Growers

Thanks for being willing to provide this feedback. It is important that we are able to understand how useful the information being presented at the field day was and whether you were able to apply any of it.

1. Which group best describes your role:

- ☐ Producer/Manager
- ☐ Farm employee
- ☐ Consultant/Vet or Advisor
- ☐ Government employee
- ☐ Service provider
- ☐ Other (Please describe)

2. If a producer, please note the type of vegetables you grow and the approximate number of hectares you use to grow these vegetables?

- | | | | | |
|--|---|--------------------------------|--------------------------------|---|
| <input type="checkbox"/> Asian Melons | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Brassicas(choy sum etc) | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Chilli | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Capsicums | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Cassava | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Cucumbers | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Eggplant | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Herbs and Spices | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Lettuce and leafy veg | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Okra | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Onions | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Pumpkin | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Snake Bean | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Squash or zucchini | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Taro | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Tomato | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |
| <input type="checkbox"/> Other | <input type="checkbox"/> less than 1 ha | <input type="checkbox"/> 1-2ha | <input type="checkbox"/> 2-5ha | <input type="checkbox"/> greater than 5ha |

3. If a producer, what type of farming best describes your vegetable farming practices? You can tick more than one system.

- ☐ Hydroponics in shade-house
- ☐ In-ground in shade-house
- ☐ In ground permanent -horizontal trellis
- ☐ In ground removable vertical trellis
- ☐ In ground open field

4. Which of the following vegetable project activities or information have you attended or accessed and how useful did you find this for your vegetable business?

<input type="checkbox"/> Vegetable workshops	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Vegetable IPM field day	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Soil Wealth field day	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Innovation group meetings	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Facebook page	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> SMS alerts	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> E-newsletter	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Reports and notes	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> One-one farm visit	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful
<input type="checkbox"/> Other:	Of no use <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 Very useful

5. As a result of what you have gained through these sources, what actions (if any) have you taken or changes have you made to your advice or farm practice?

☐ Yes ☐ No

If yes, what change have you made? If no, go to Q 9.

6. If Yes, how much sooner did you make this change as a result of the project information or activities than you may have done otherwise (please tick)?

- ☐ Sooner than I would otherwise have done so
☐ I don't expect to make a change:

If sooner, number of years sooner (0 if it was planned for current year anyway):

7. Overall, what project activity or information related information was most influential in making the change?

8. What other sources of information or support assisted you with this change?

9. If you have made a change on your farm or (for consultants – with your advice), what benefits or impact has this had on your enterprise (or your client's) - or do you expect it to have? Please comment:

10. What has stopped you – or made it difficult to – make changes in this area?

11. What further information or assistance would help you in making (further) changes to your management?

12. Please make any other comments about the project activities or information, emerging issues or future needs:

Thanks for your time and insights.

FREE

Signed up for AUSVEG magazine

Signed member of Hort Innovation

Narrative Example

Date:	December 5, 2016
Submitted by:	Greg Owens
Industry:	Vegetable Industry
Issue:	North Australian Quarantine Survey (NAQS) including commercial vegetable farms
Stakeholder:	An Asian vegetable grower Tuan Dang, who has a mixed Asian vegetable and tropical fruit farm on 2 x 20ha adjacent blocks at Marrakai, NT. Tuan is a leading grower and industry champion in the Asian vegetable community in the Top End and has farmed in this area with his brother Hung Dang for 19 years.
Engagement:	Tuan allowed the NAQS team to include his property in one of their periodic surveys of Northern Australia for exotic insects and weeds. Tuan engaged with the survey team on his farm and explained to the survey team his issues and practices with pests, and weeds. This is against a background where growers are very suspicious of any quarantine office following multiple biosecurity incursions and farm closures in the immediate area.
Reaction:	There was an excellent interchange of knowledge and practices with Tuan providing industry perspectives. The survey entomologists and botanists provided their expertise to identify some problem pests and disease and potential native beneficials while they were collecting samples for their exotic survey.
Actions:	Tuan will allow the NAQS survey to revisit his farm on a regular basis to build their knowledge of the pest and weeds on commercial vegetable farms in the Top End which is a potential exotic incursion point. Tuan will increase his personal surveillance of his farm on some of the threats discussed during the visit and has a reporting mechanism to query unknown weeds and pests. During the survey a weed thought to be a host weed for CGMMV was correctly identified by the botanist as a similar but unrelated weed that is not a known host of CGMMV
Impacts:	The initial impact is to improve relationships between a leading grower and quarantine survey officers and increase the knowledge of both parties of each other. The second impact is that the degree of management of the weed, thought to be a CGMMV host, is greatly reduced as the weed is not an identified threat to transfer the virus to the cucurbits grown on the farm. The larger potential is for a positive relationship between the NAQS survey team and growers that will improve the growing community surveillance of commercial production areas that will help safeguard the Top End industry.

Case Study Template

Case studies can be used to ‘tell a story’ or communicate project outcomes. This guide will provide a basic template for developing case studies Hort Innovation projects.

Focus your study

Usually case studies focus on one instance, site, activity or project to detail changes and outcomes that have been brought about by your project. Alternately, case studies can also be comparative, by comparing instances within or across sites or locations. A comparative study will often look for similarities and differences across cases or sites to develop generalisations and findings.

Be clear on purpose

Like any monitoring, evaluation or reporting activity it is necessary to be clear on why you are conducting a case study beforehand. Case studies can be used for a range of purposes including:

- To illustrate and describe particular project events or achievements.
- To explore issues of particular importance to a project or context.
- To examine a specific and unique event in some detail.
- To describe implementation processes. For instance, describing how the project or activities have been delivered.

An evaluation case study may be used for communications purposes but it is critical that evidence is used to support findings in an evaluation case study¹.

Format

The format of your case study may vary depending on the case and audience for the study. A common format that may be used is:

- Context – Describe the setting including who was involved. What is the overall problem or issue being addressed? Why is this important?
- Activity – What happened? Who was involved? Where? When? etc.
- Outcome – So what? what happened as a result of the activity or event? What changes in knowledge, attitude, skills and aspirations (KASA) or practices occurred?
- Learning / reflection – What now? What are the implications or learnings from the instance/s described?

Writing it up

Depending on the use and audience a case study can be anywhere between a paragraph and several pages in length. It worth considering using other media such as pictures, figures to convey findings.

¹ See: <http://www.clearhorizon.com.au/discussion/make-your-case-how-to-develop-and-use-case-studies/#ixzz3Cp3jTAK> and http://betterevaluation.org/plan/approach/case_study for more detail.

VG15044 Action Plan for 2017

Appendix 20

Grower activities

Topic	Activity	Who	What	Where & When	How	KPI's
Current practices Survey	Yearly survey of veg growing practices and project impact	VG15044	A general survey will be developed to be sent or administered to as many NT veg growers as possible	The survey will be commenced at the start of the traditional vegetable season in April. It will be revisited at workshops and meetings until June 2017.	The survey will be administered through a variety of media, electronic, phone, farm visits and at IPM and other veg workshops and meetings. Data collected through all these sources will be compiled and analysed establish baseline practices and to gauge industry impact of project.	50 growers complete and return first annual survey Survey results published and baseline practices established by July 2017
Grower trips	National Horticulture Convention	VG15044	Application for funding assistance to attend seminars associated with National Convention	As funding details become available probably Feb Mar 2017	Apply for funding for veg growers for airfares and accommodation to attend National Convention seminars and workshops	At least 2 different veg grower attend National Horticulture Convention in Adelaide May 2017 and associated seminars and workshops
Soil Wealth Demo site	Biochar and cover crop trial	VG15044 & TNRM and grower	Field walk pre-establishment and at peak production. Soil sampling and analysis as per soil wealth trial outline	Lambells lagoon Soil wealth trial site Cover crop Field walk February Soil sampling after cover crop in March Field walk in June/July	Continue year 2 trial of biochar and cover crop on veg crops at the Lambells Lagoon site A field walk for growers to see cover crops in place. A second field walk in June/July during peak vegetable production to discuss variations due to treatments	10 growers attend the both field walks Soil samples are collected and sent for analysis Results are analysed for trends against trial treatments and results published on appropriate sites

Biosecurity	CGMMV R&D Report back meetings and workshop	NTFA to coordinate with NTDPIR Research and Biosecurity staff	Information and training on market access compliance for CGMMV to other states. On-farm biosecurity procedures reviewed	Workshops at Katherine research Station and at NT Farmers office 15 December 2016 and March 2015	Workshops to inform growers of the progress of research into aspects of CGMMV management. Discussions on current on-farm biosecurity and recommendations for improvement.	50% of NT Cucurbit Growers attend workshops in Katherine and Darwin Amendments to on-farm biosecurity plans as recommended by the R&D project incorporated into the online version of the CGMMV farm biosecurity plan
	Host Weed monitoring and CGMMV management	VG15044, NAQS & NTDPPIF Quarantine & Plant Pathology	Training to take and submit plant samples to Herbarium for identification and Plant Pathology for virus testing, or participate in NAQS survey	NAQS survey ongoing at 3 monthly intervals. Sampling demonstration and practice at workshops for IPM	CGMMV Host Weed updated information available to growers from VG15013	At least 2 Vegetable farmers participate in NAQS survey Weed samples are submitted to the NT herbarium by NT cucurbit growers for identification Common weeds on NT cucurbit farms are identified accurately Fact sheet prepared. Host weeds list for CGMMV updated and distributed
	CGMMV NVEN webinar	VG15044, NTDPIR and NVEN	Training webinar for NVEN projects across Australia on CGMMV management	March 2017	VG15044 will coordinate and run a webinar for NVEN project officers and other key personnel across Australia to relate NT and WA experiences and upskill the project officers on CGMMV incursion and on-farm management options	Webinar conducted and feedback evaluated and reported

Pest and disease management	Best practice demonstration site for IPM and BEE Friendly farming at CPRF and on champion growers site	NTDPIR, VG15044 and cooperating growers	Demonstration site for insect control in non-cucurbits using IPM techniques at CPRF and compare to conventional farming practices.	Field days at CPHRF will begin in May and at least 3 will be held across the veg season	Dedicated area to IPM and conventional farming demo site. Weekly pest and beneficial assessment and publication of pest numbers, bee numbers and control methods. Costs and Yields to be recorded and compared	IPM demo site completed and operational by May 2016 30 + Growers attend field days Fact sheet produced on beneficial and pest species present Updates on IPM site published in NTFA e-news at least fortnightly after May 2017 Production data from both systems published by November 2017 Suggested IPM strategies and thresholds published for snake bean and okra production.
	IPM champion growers site		Farm walks as possible on grower site	Site and grower to be determined depends on CGMMV status and IPM protocols and IPM commitment	Champion growers to recount their experiences and be on hand to discuss their progress	20 growers attend field walk on grower property Case study produced on grower's experience
	Pest and disease ID workshop with the use of the Pest and Disease handbook	VG15044 & NTDPIF Entomology and Plant Pathology	Field and lab activity	Coastal Plains Research station IPM Demo site Feb- March 2015 Pre-establishment of vegetable crops	Samples of NT pests, diseases (non-CGMMV) and beneficials at different life cycle stages will be presented for identification with the assistance of experienced field staff.	30 Growers attend workshop at CPRF Fact sheet on common pests and beneficials for snake bean and okra produced

Improved Fertigation techniques (if time and resources permit) (May be done in conjunction with IPM demo site)	Demonstration of automated fertigation equipment for fertigation injection and irrigation scheduling	NTDPIR & VG15044	Demonstration site for improved fertigation techniques Demonstration Field Activity as possible	Site and grower was determined but now depends on CGMMV status and protocols Field Activities CPRF Early growth May 2017 Early production June 2017 Older plants August 2017	Equipment, fertiliser and labour costs collected and published for current practice and improved fertigation practice. Soil and leaf nutrient testing to confirm/demonstrate fertiliser utilisation efficiency.	
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VG15044: VegNET – Workplan (2017-2018)

Topic	Activity	Who	What	Where & When	How
Water (regulation and timing dependant)	Water compliance workshop	VG15044 & NTDENR	Information and training on compliance for water licensing and efficient water use.	Workshops at NT Farmers February – March 2018	Series of meeting workshops to inform growers of the water licensing requirements and to practice required recording, reporting, measuring and good management of water on farm. Discussions on current on-farm water recommendations for improvement.
	Water Use Seminar	NT Farmers NTDENR EE Muirs	A seminar on the effects, management and current research of best practice water use	Seminar at NT Farmers Jan 2018 and May 2018	Will present seminars on water use, growers will get the opportunity to discuss current response and regulations. Could be combined with a regulation update.
	Farm data collection, tech training and licensing process for water.	VG15044 & NTDENR	Training to monitor and record water use, using basic technology.	TBA Neutral non- CGMMV sensitive points when CGMMV sampling protocols are established and on farms following the best practice market access training. March-April 2018	The monitored crops need to be grown and verified virus free before the workshop to allow growers to practice monitoring.

1. Pest and disease management	Pest and disease ID workshop with Pest Field Guide	VG15044 & NTDPIR Entomology and Plant Pathology	Field and lab activity Workshop on ID of veg pest, diseases & disorders	IPM Demo Site March-June 2018	Samples of NT pests, diseases (non CGMMV) and Beneficials at different life cycle stages will be presented for identification with the assistance of experienced field staff.
	Best practice demonstration site for IPM and Bee Friendly farming.	VG15044 and NTDPIR & Landcare	Demonstration site for caterpillar & mite control using IPM techniques. Farm walks as possible	Coastal Plains Research station March-Sept 2018 (attached workshop & field day schedule)	Weekly pest and beneficial assessment and publication of pest numbers, bee numbers methods. Costs and Yields to be recorded and compared.
Improved Fertigation techniques	On farm IPM monitoring & systems development	VG15044 to cooperating growers. NTDPIR	Development of beneficial insect calendar	Recorded from IMP demo plot	Dedicated area to IPM and control on farm and harvested by farmer
	Demonstration of automated fertigation equipment for fertigation injection and irrigation scheduling Use of hydroponic systems to reduce soil pest and disease issues in snake beans.	VG15044 and cooperative grower	Use demonstration site for improved fertigation techniques. Demonstration Field Activity as possible	IPM Demo Site and on farm with leading grower - depends on CGMMV status and protocols Start April-May 2018	Equipment, fertiliser and labour costs collected and published for current practice and improved fertigation practice. Soil and leaf nutrient testing to confirm/demonstrate fertiliser utilisation efficiency.
Vegetable grower's evaluation survey	Evaluation survey	VG15044 and cooperating industry	Survey	Oct – Dec 2018	A series of interviews to survey the growers and industry involved in VG15044 on the impacts of VG15044

Asian Vegetable Growers forward planning interviews.	Informal but rigorous strategic planning process for Asian Veg in NT.	VG15044 Asian veg growers in Top End Look to vegetables WA for a Vietnamese facilitator	Use the engagement generated by the project survey to discuss and plan for R, D & E requirements for the next year.	At the end of the growing season before they all go on holidays. Wet season 2018.	Coordinate with end of year events. Circulate discussion paper, or ideas using small groups and champions prior to planning meeting. The process must have ownership by the growers.
Chemical Handling	Training specific to growers	VG15044 and cooperating grower	Training to improve best practice	Apr/May 2018 Post-Harvest Work Shop at NT Famers	Trainer TBA. Provide 2 chemical handling course for growers. English speaking and Provide translator for Asian community
Post-Harvest Management	Paddock workshop & Biosecurity	VG15044 Veggie growers	Best Practise techniques for profitability	May/June 2018 Coastal Plains ??	Jenny Eckman, AHR
Basic Skills workshop	Pest & Diseases I.D. & Biosecurity	VG15044, Growers & Staff	Value add to NTFA IMP demo plot.	June 2018	Paul Horne & Angelica

Irrigation Monitoring	Understanding requirements Flow meters, fertigation, back flow protection at the bore head	VG15044, Growers and cooperating industry	Complement IMP demo plot, understanding water requires with new policy	Jul/Aug 2018	Speakers TBA. Meeting workshops to inform growers on uses, requirements management of water recording on farm. Discuss current on-farm water recommendations for improvement.
Coaching Groups with similar Interests	Mentoring youth for future industry leaders, growers Youth Development program	VG15044, Growers children, youth in industry	Complement AusVeg Young Leaders	ASAP bring together & commence regular meetings	Improvement relationship, find ways to encourage youth into the Hort sector
Hort Code of Conduct	Webinars, general & multi-language specific to Vietnamese & Cambodian with translator	VG15044 Growers & including Veg industry related members	Workshop to assist growers signing agreements with merchants	Feb/March 2018	Sophie Lapsley, Grow Com
Veg Innovations	Working in industry, more pre-crop info, Veg WHS tools, careers in Veg promotion	VG15044 Growers & Veg industry related members	Workshop to promote and inform growers of the requirements and relevance's to a sustainable industry practises	March/April 2018	TBA

Workplan (2018-2019)

Topic	Activity	Who	What	Where & When	How	Achievements	Aims
Pest and Disease Management	On farm IPM monitoring & systems development	VG15044 to cooperating growers. NTDIPR	Development of beneficial insect and plant growth stage calendar Continue to update the beneficial insect and plant growth stage calendar 2019	Recorded from IMP demo plot 30 th Aug 2018	IPM area dedicated to on farm control, harvested by farmers	Beneficial & pest calendar developed with the addition of plant growth stage Employment of young Asian growers	Raise awareness of beneficial biological use in farming systems by producing a visual aid growers can refer to
Water (regulation and timing dependant)	Water compliance workshop	VG15044 & NTDENR Re-Sellers	Information and training on compliance for water licensing and efficient water use.	Workshops at Coastal Plains Research Farm 6 th Sept 2018	Workshops to inform growers of the water licensing requirements and to practice required recording, reporting, measuring and good management of water on farm. Discussions on current on-farm water recommendations for improvement.	Grower awareness and understanding around compliance requirements	Providing support to growers through workshops information and training on compliance, especially to non-English speaking growers. NTFA has/will encouraged farmers to come forward for assistance with understanding

	Water Use Seminar	NT Farmers AHR/VegPro NTDENR Re-Sellers	A seminar on the effects, management and current research of best practice water use	Workshop at Coastal Plains Research Farm 6 th Sept 2018	Present on water use, give growers the opportunity to discuss current regulations. Could be combined with a regulation update.	Grower concerns were addressed, and current regulatory requirements presented	around licence requirements
	Farm data collection, tech training and licensing process for water.	VG15044 & NTDENR NTDPiR	Training to monitor and record water use, using basic technology.	On farms following the best practice market access training. 2019	The monitored crops need to be grown and verified virus free before the workshop to allow growers to practice monitoring.	This was achieved through our pre-season meetings held in both Katherine & Darwin Though the use of G-dots & Moisture probes used at the demonstration site Coastal Plains	Provide training for correct recording of data for best practice to help prevent incursions. Obtain current water use information for industry in NT on various crops
Pest and disease management	Pest and disease ID workshop with Pest Field Guide	VG15044 & NTDPiR Entomology and Plant Pathology	Field Walks and lab activities Workshop on ID of veg pest, diseases & disorders	IPM Demo Site 30 th & 31 st Sept 2018 June 2019	NT pests, diseases and Beneficials at different life cycle and growth stages calendar will be presented to growers with the assistance of experienced NTDPiR field staff. For on farm use	Through Field Walks conducted by Laura Cunningham, Greg Owens & Brian Thistleton, Haidee Brown	Enabling farmers to visually identify the differences between beneficial predators occurring naturally in their area versus pests at plant growth stages

Vegetable grower's evaluation survey	Evaluation survey	VG15044 and cooperating industry	Survey	Oct/Nov 2018	A series of interviews to survey the growers and industry involved in VG15044 on the impacts of VG15044	Completed via Face to Face interviews	Helping growers to change practices earlier through project demo site without them having any financial out lay
Asian Vegetable Growers forward planning interviews.	Informal but rigorous strategic planning process for Asian Veg in NT.	VG15044 Asian veg growers in Top End Look to vegetables WA for a Vietnamese facilitator	Use the engagement generated by the project survey to discuss and plan for R, D & E requirements for the next year.	At the end of the growing season before they all go on holidays. Wet season Dec 2018.	Coordinate with end of year events. Circulate discussion paper, or ideas using small groups and champions prior to planning meeting. The process must have ownership by the growers.	Grower survey results revealed planning focus for next year's project	Engaging to acquire grower needs to facilitate the following seasons requirements
Chemical Handling	Training specific to growers	VG15044 and cooperating grower	Training to improve best practice	18 th 19 th Feb 2019 required for vegetable growers chemical certificate renewals	Trainer James Gorrie, Train Safe NT. Provide 2 chemical handling course for growers. Non-English speaking, translator required	Funding unknown, local trainer & translator	Providing growers access to certification renewal training, via translation assistance enabling certification for industry standards.
Post-Harvest Management	Paddock workshop & Biosecurity translation of the CGMMV farm	VG 15044 Veggie growers	Best Practise techniques for profitability	June-July 2019 Coastal Plains	Biosecurity Officer Chris Pham	TBA	Visually demonstration to emphasize and encourage best practise Biosecurity using the Demo site.

	biosecurity plan template into Khmer							Increasing profitability through sustainable production to producing quality products
Basic Skills workshop	Pest & Diseases I.D. & Biosecurity	VG15044, NTDPIR, NAQS Growers and industry stakeholders	Value add to NTFA IMP demo plot.	2019 Workshop NTFA Field Day 2019 July Coastal Plains Research Farm	2019 Melon and Veg Growers 2019 Possible Speakers Paul Horne & Angelica Biosecurity Officer Chris Pham	VegPro funded for support from external stakeholders to present TBA	Enabling growers to identify pests and diseases. While promoting and informing growers of requirements and relevance's of sustainable industry practises	
Irrigation Monitoring	Understanding requirements Flow meters, fertigation, back flow protection at the bore head	VG15044, NTDENR Re-sellers Growers and cooperating industry	Complement IMP demo plot, understanding water requires with new policy	6 th Sept 2018 Coastal Plains Research Farm. To be continued in March 2019	Meeting/ workshops to informing growers on uses, requirements management of water recording on farm. Discuss current on-farm water recommendations for improvement.	TBA	Reiterate and update grower knowledge around requirements. While refining current crop recommendation	
Coaching Groups with similar Interests	Mentoring youth for future industry leaders, growers Youth Development program	VG15044, NTFA, Growers children, youth in industry	Complement AusVeg Young Leaders	Bring together Young NT Farmers through regular monthly Meetings, ongoing 2018-2019	Improve relationship, through interaction and connect young industry from all sectors, find ways to encourage and support youth into the Hort sector	Continuation of the NT Young Farmers Group	Identify key young growers to provide leadership through networking in their communities for the future of the industry	

Hort Code of Conduct	Delivery of Certification and training courses for best practices requirements	VG15044 Growers & including Veg industry related members	Workshop to assist growers signing agreements with merchants	March 2019 May	VegPro Funded workshops to provide growers with current practise & new program information	VegPro Funded information sessions on HACCP, Fresh Care & the introduction of HARPS	Building awareness of the current changes & requirement to protect and benefit growers. VegPro
Veg Innovations	Working in industry, more pre-crop info, Veg WHS tools, careers in Veg promotion	VG15044 Growers & Veg industry related members	Workshop to promote and inform growers of the requirements and relevance's to a sustainable industry practises	April-Sept 2018 Careers Alice Springs 13 th -14 th Aug 24 th -25 th Aug Darwin	Engaging with ICAS NT to update & roll out PISAFEN NT Careers Expo with WPC, NTFA	Hand out of Veg WHS Carrots to grower's industry and stakeholders Attending Careers Expo to promo careers in industry	Provide pre-crop information, WHS awareness while encouraging careers in industry